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Cover illustration: *Sciaphilus asperatus* (Bonsdorff) (Coleoptera: Curculionidae), Nunhead Cemetery. Photo: R. A. Jones.

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ANT DEFENCE OF COLONIES OF *APHIS FABAE* SCOPOLI (HEMIPTERA: APHIDIDAE), AGAINST PREDATION BY LADYBIRDS

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INTRODUCTION

The symbiosis of ants and honeydew-producing aphids is well studied (Way, 1963). Most myrmecophilous Homoptera show behavioural and structural modifications for life with ants. The ants eat honeydew, a waste product of the aphids. Honeydew is rich in carbohydrate and also contains free amino acids and amides (Ewart & Metcalf, 1956; Gray, 1952; Maltais & Auclair, 1952; Mittler, 1958), proteins (Maltais & Auclair, 1952), minerals and B-vitamins (Hagen, 1962). The ants may also obtain protein by preying on excess aphids in and around the colony (Nixon, 1951; Pontin, 1958). The assumed benefits to the aphids are primarily protection from natural enemies and improved hygiene through removal of honeydew and dead aphids. There is conflicting evidence concerning direct action by ants to defend aphids. El-Ziady & Kennedy (1956) showed that *Lasius niger* L. workers attacked and drove away larvae of *Adalia bipunctata* L., and adults of *A. bipunctata*, *Coccinella 7-punctata* L. and *Propylea 14-punctata* L. Banks (1962) observed that ants of this species remove coccinellid eggs from the vicinity of attended aphids. However, other workers have recorded that *L. niger* rarely interferes with adult coccinellids feeding on its attended aphids, Herzig (1938) and Wichmann (1955) both concluding that coccinellids preying on *L. niger*-tended aphid colonies are little affected by ants. A similar set of contradictory observations may be found in the literature on *Formica rufa* L. Wellenstein (1952) and Kloft (1953) report that only newly emerged or very old adult coccinellids were attacked, while Majerus (1989) reports adults of nine out of ten species of coccinellid, and larvae of two out of three species, were attacked and driven away by *F. rufa*. The one exception was that both larvae and adults of *Coccinella magnifica* Redtenbacher, a known myrmecophile (Donisthorpe, 1920, 1927, 1939), were ignored by the ants. Majerus (1989) suggests that this species uses pheromonal manipulation of the ants to allow it access to a large food source in the form of ant tended aphids.

Nixon (1951) concludes that any protection afforded aphids by their association with ants is only incidental, ants either accidentally disturbing some aphid predators or being naturally hostile to rapidly moving organisms including a number of aphid predators. More recently other authors (Way, 1963; Rotheray, 1989) have suggested that this is an over-simplification, and that the relationships between ants, aphids and aphid predators are more complicated and still little understood.

The aim of this project was to look at the behavioural interaction between ants and ladybirds.

METHODS

Fieldwork was carried out at Juniper Hall Field Studies Centre, Mickleham, Surrey, from 27 June to 3 July, 1991. A natural colony of *Aphis fabae* (black bean aphid)

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on *Cirsium arvense* L. (creeping thistle) tended by *Myrmica ruginodis* Nylander was studied. There were approximately 40 ants on the aphid colony at any one time. A similar colony tended by *L. niger*—about six ants on the colony at any one time—was used for some preliminary tests and observations.

Ladybirds were collected from nettle beds in the vicinity of the Field Centre. They were kept in petri dishes for 1–2 days before the experiment. Ladybirds were starved prior to the experiment to ensure that they would be hungry and take an interest in the aphids. This standardized, at least to some extent, the nutritional status of the ladybirds.

A single ladybird was placed on the stem of the thistle 5 cm below the colony. Ladybirds are positively phototactic and negatively geotropic (Majerus & Kearns, 1989) so they tended to walk up the stem towards the colony. A variety of species of ladybird were used (see Table 1).

The results were recorded as a series of timed observations, noting, for example, each encounter between a ladybird and an ant, its position relative to the aphid colony, and the result of the encounter.

The experiment ended when the ladybird walked or flew off the plant, or went into a prolonged state of inactivity away from the colony. If it cleaned itself after an encounter with an ant, this was recorded. Sometimes the ladybird would start food-searching behaviour away from the colony without encountering an ant or aphid. This was recorded and the experiment ended by removing the ladybird. Another individual was then placed on the stem. Virtually all aphid colonies in the vicinity were tended by ants; however, one similar but untended aphid colony was found and this was used to carry out a small run of experiments as controls.

Table 1. Number of experiments with each species of coccinellid used. The finding of only one untended aphid colony meant that few control tests could be conducted.

		Experiments	Controls
Carnivorous species			
Adults			
Adalia bipunctata	(2-spot ladybird)	21	5
Coccinella 7-punctata	(7-spot ladybird)	13	4
Calvia 14-guttata	(cream-spot ladybird)	5	
Propylea 14-punctata	(14-spot ladybird)	5	
Myrrha 18-guttata	(18-spot ladybird)	3	
Anatis ocellata	(eyed ladybird)	1	
Exochomus 4-pustulatus	(pine ladybird)	2	
Myzia oblongoguttata	(striped ladybird)	2	
Non-carnivorous species			
Halyzia 16-guttata	(orange ladybird)	5	
Micraspis 16-punctata	(16-spot ladybird)	2	
Psyllobora 22-punctata	(22-spot ladybird)	8	
Larvae			
Adalia bipunctata	(2-spot ladybird)	5	
Coccinella 7-punctata	(7-spot ladybird)	4	
Anatis ocellata	(eyed ladybird)	3	

Two different aspects of the attack behaviour of the ants when they encountered a ladybird were recognized and recorded; (i) one or more ants managed to grab hold of the ladybird; and (ii) one or more ants squirted formic acid at the ladybird, recognizable when an ant curls its abdomen under its body towards the ladybird. This was often difficult to see and may not have been recorded in all cases. A variety of ladybird behaviours were recorded (see Table 3).

Each encounter, defined as contact between an ant and a ladybird which had not been in contact with any ants for the previous 10 seconds, was recorded. This was designed to eliminate cases when ants came in to help or to take over from others which had already attacked.

Each encounter was scored as either 'investigate' or 'escalate'. Investigate indicates that the ant touched the ladybird, generally with its antennae, but did not fight. Escalate indicates that the ant did attack. Attacks generally took the form of biting at the elytra or legs, squirting formic acid, or pushing to try to dislodge the ladybird. It should be noted that our analysis does not take into account the duration or ferocity of the attack—it only analyses the initial decision to attack.

Hypothetically, this decision will depend on the ants making some assessment of the threat to their food supply, in this case the colony of aphids, which in turn could depend on a variety of factors: how valuable the food source is, whether the food is scarce or abundant, how far the food source is from the ants' nest, and how close the predator is to the colony. To assess this final factor, encounters were divided into those before the ladybird reached the colony and those while the ladybird was actually on the colony.

Once a ladybird had been found on the colony the ants seemed to become more active and attack. To assess this the encounters between ants and ladybirds on the colony were split into those within the first 2 minutes after contact with the colony and those more than 2 minutes after initial contact. Two minutes were chosen arbitrarily.

As a large number of repeat experiments were conducted on the same colony there is a possibility that the ants' basic level of hostility changed during the day—this did not appear to be the case, but it is a possible criticism of the method used.

RESULTS

Summary of observations

A summary of the results of encounters between ants and ladybirds is given in Table 2. Typically, when introduced onto a stem, the ladybird ran up and reached the colony of aphids fairly quickly. In most cases the encounter with an ant occurred after the ladybird had reached the colony. The ant first palpated the ladybird with its antennae. In many cases the ants then escalated to attack behaviour. Other ants often joined in the attack, up to five being seen attacking at one time. Each ant only persisted with an attack for about 30–60 seconds, although continual recruitment of new ants meant that ladybirds were often under sustained attack for several minutes. In cases where an ant managed to secure a hold on the ladybird with its mandibles, usually on a leg, the ant's attack was often sustained for longer, in one case for 14 minutes.

It appeared that the elytra of adult ladybirds are defensively very effective against ants and, in our experiments, ants only gained an effective hold on six of the 67 ladybirds used.

In cases where an ant encountered a ladybird with an aphid in its mandibles, the ant tended to concentrate on retrieving the aphid rather than attacking the ladybird. This was despite that fact that the aphid was often already fatally injured.

Table 2. Details of ladybirds which successfully ate aphids. Results are only for carnivorous ladybird species.

(1) On the colony	two of 52 ladybirds (4%) ate an aphid from a colony tended by ants.
	five of nine ladybirds (56%) ate an aphid from the colony not tended by ants.
	five of 52 ladybirds got hold of an aphid but had it retrieved by the ants.
(2) Away from the colony	five of 52 ladybirds (10%) ate an aphid away from the colony.
	one of 52 ladybirds got hold of an aphid away from the colony but had it retrieved by ants.

(Aphids away from the main colony were either winged individuals walking on the leaves of the plant or sessile individuals feeding away from the colony).

Note: 26 ladybirds out of 52 reached the colony.

The results for the 'ladybird success rate' (see Table 2) show the enormously reduced success rate of ladybirds when the aphids had ants in attendance, compared with the control colony.

In order to determine the nature of the stimulus that induces ants to attack, a 'pseudo-ladybird' was made out of Blu-Tack and coloured red and black. This was stuck onto the thistle to see how the ants responded. It was totally ignored by the ants, even when an aphid was squashed in the process of putting it onto the plant. This suggests that it is either the movement of the ladybird or a chemical stimulus from the ladybird that provokes the attack and not just the presence of a foreign body on the aphid colony.

Table 3. Summary of results of experiment for all ladybird species, including non-carnivores, combined.

	Larvae	Adults	Control
Reaches aphid colony	5	31	6
Encountered ant(s)	8	44	—
Ant grabbed ladybird	2	6	—
Ant squirted acid	1	8	—
Ladybird dropped off	2	9	—
Ladybird clamped down	—	8	—
Ladybird returned to colony	—	5	—
Ladybird flew off	—	22	1
Ladybird stayed away	6	27	4
Ladybird ate an aphid on colony	0	2	5
Ladybird ate an aphid away from the colony	2	5	0
Total individuals used	12	67	9

The response of ladybirds to ant attacks varied between species. These differences are summarized later. In general ladybirds either clamped down as soon as attacked, presumably to prevent ants gaining an effective hold on them, or they moved away from the colony. In some cases the ladybirds only moved a short distance from the colony, returning to it once the ant attacks had subsided. In other cases, the ladybirds moved further from the colony and did not return.

After a sustained attack, and especially if squirted with formic acid, the ladybird often escaped up a leaf and clamped down for several minutes before starting to clean itself. This self-cleaning took several minutes on and off, the duration of cleaning being longer when they had been sprayed with formic acid.

One ladybird defence mechanism is 'reflex bleeding' (Majerus & Kearns, 1989). When attacked, a pungent yellow fluid is exuded from pores in the ladybird's legs, from where it runs along channels to the edge of the pronotum or elyta, where it forms small droplets. This defence was not used by the adult ladybirds against the ants in any of our experiments. On the other hand, the ladybird larvae did reflex bleed in response to sustained ant attacks. The reflex blood was secreted mainly from the 1st, 2nd, 8th and 9th abdominal segments, although other points of secretion were seen and it is possible that a secretion can be at any attack point on the abdomen, or at the base of the legs. It appeared to be used as a last-ditch defence against prolonged attacks. This may be because it reduced mobility as it tended to foul-up the larva's legs. Individual larvae only produced large amounts of fluid once, implying that the reservoir of fluid available at any time is limited. Indeed, it has recently been shown that adult *A. bipunctata* and *C. 7-punctata* only have a limited supply of reflex blood (de Jong et al., 1991; Holloway et al., 1991).

The failure of adults to reflex bleed in response to ant attacks probably indicates first, that reflex blood is a valuable resource which is costly to replenish, and secondly, that ants are not a serious threat to adult ladybirds, at most depriving them of a meal and costing them cleaning time. On the other hand, larvae, with their softer exoskeletons, are far more vulnerable to ant attacks, and are more likely to be killed (Majerus, 1989). Their use of reflex bleeding against ants is presumably a reflection of this greater vulnerability.

In terms of ladybird success, that is a ladybird actually managing to eat an aphid, a summary of the results is given in Table 2. For carnivorous ladybirds, the success rate on ant-tended aphid colonies was significantly lower than on the untended colony ($\chi^2_1 = 19.84$, $P < 0.001$ with Yates' correction). (This test uses totals released onto plants rather than just the number which reached the colony because it was noted that presence of ants on a plant could prevent the ladybird reaching the colony.) This result shows that ants do significantly reduce the effect of predation by ladybirds on aphid colonies. That five aphids were eaten by ladybirds on the plant supporting ant-tended colonies, but away from the main colony, suggests that first, it is ordinarily the main colony that the ants defend, and secondly, there is a considerable advantage to aphids in remaining within the main colony, in terms of reduced risk of predation.

The results of the ants' responses to ladybirds in terms of investigation and escalation are given in Table 4. The level of ant response before the ladybird reaches the colony can be used as a basic level of hostility before the ladybird has posed a direct threat to the aphid colony. Statistical comparisons of this base level with the level of response in the other classes show that the proportion of ants which escalate attacks is significantly increased while the ladybird is on the aphid colony ($\chi^2_1 = 13.18$, $P < 0.001$), and during the first 2 minutes after the ladybird has left the aphid colony ($\chi^2_1 = 7.29$, $P < 0.01$). However, there is no significant difference between the base

Table 4. Summary of the responses of ants on encountering ladybirds (carnivorous and non-carnivorous species combined).

Ant response	Before ladybird reaches colony	While ladybird is on colony	0–2 mins after ladybird has left colony	>2 mins after ladybird has left colony
Investigated, then escalated	11	33	18	15
Investigated only	18	8	6	15

level of response and the level more than 2 minutes after the ladybirds have left the colony ($\chi_1^2=0.87$, $P>0.1$). Notably, there is also no significant difference between the level of ant response to ladybirds on the colony and in the first 2 minutes after the ladybirds have left the colony ($\chi_1^2=0.27$, $P>0.1$). We conclude that there is a significant increase in ant hostility when the ladybird reaches the colony. This level of hostility begins to decrease some time after the ladybird leaves the colony and has effectively returned to the base level after about two minutes.

Species-specific notes

The above summary of results applies to most of the ladybird species used, but *A. bipunctata* and *C. 7-punctata* in particular. Although we did not do enough repeats to analyse the data statistically for differences between species, notes on the behavioural interactions of each species were made. Here follows a summary of these notes.

Propylea 14-punctata (14-spot ladybird)

On contact with ants, it employs a strange jolting action which appeared to be an attempt to shake ants from its back.

Myrrha 18-guttata L. (18-spot ladybird)

The ants seemed very aggresive towards this species and attacked continuously both before it reached the colony and afterwards on leaves at some distance from the colony. The ladybird continually ran away but the ants persisted in their attacks. It has been suggested that this species is a Scots pine specialist, breeding almost exlusively in the higher branches of mature trees (Majerus, 1988; Majerus & Kearns, 1989). It is feasible that by restricting reproductive activity, and in particular oviposition, to the tops of these tall trees, they avoid the extremely violent behaviour of the ants towards them. Why ants should react more aggressively to this species than others is not known.

Anatis ocellata L. (eyed ladybird)

When an ant managed to get hold of its leg the ladybird successfully dislodged the ant by kicking with its other legs. A larva of this species was the only ladybird which the ants successfully killed and carried off. Up to seven ants at a time carried the dead larva. The ants would lose interest for several minutes at a time and then start again, always moving the body down the plant.

Exochomus 4-pustulatus L. (pine ladybird)

This small ladybird has a rim around its elytra so that it fits very tightly against a flat substrate when clamped down. It is then almost impregnable. It clamped down very readily.

Myzia oblongoguttata L. (striped ladybird)

One of the two used successfully ate an aphid. Both stopped still when attacked and waited until the ants gave up rather than running away.

Non-carnivorous species

Halyzia 16-guttata L. (orange ladybird)

Very active and mobile. Made no attempt to clamp down when attacked, but ran away immediately and tried to fly. Although primarily a mildew feeder, the orange ladybird may eat small aphids when food is scarce (Majerus & Kearns, 1989). One of our specimens did grab hold of an aphid.

Micraspis 16-punctata L. (16-spot ladybird) and
Psyllobora 22-punctata L. (22-spot ladybird)

Neither of these species encountered aphids in the trials as they went straight up the nearest leaf each time, presumably as a result of different food searching behaviour associated with mildew feeding. Ants encountering these species treated them in the same way as carnivorous species.

Discussion

In our experiments, the ants are clearly vigorously defending the aphid colony. There is definitely more than just accidental disturbance of aphid predators. Nixon's (1951) conclusion of incidental protection of the aphids, is not borne out by our experiments.

Way (1963) summarized three reasons why ants may attack other insects: (1) if the ant is a predatory species which would be expected to attack most insects in their foraging territories; (2) if other insects are hostile to the ants themselves, and (3) if the other insect intrudes on the nest or on a food source which the ant is monopolizing.

The attacks in our experiments are clearly not a predatory effect as the ladybird is rarely physically injured, let alone killed. Also, if this were the case, one would expect an equal likelihood of attacks at any point on the plant. However, our ladybirds were often ignored when on leaves away from the colony, but attacked when near or on the aphid colony. The results for the ant response data also show this—the ants were far more likely to attack after the ladybird had reached the colony than before.

The ladybirds did not appear to be hostile to the defending ants, only to their attended Homoptera. We conclude that this is a case of ownership behaviour.

Variation in the assiduousness of the ants' tending of colonies may explain in part the ladybirds' strategy. There would at first appear to be little reason for the ladybird remaining on a plant after first encountering the ants. Their feeding success rate was minimal and they were liable to continual attacks from the ants. However, in view of the fact that the ladybirds are relatively immune to attack due to their protective

elytra and that many tended colonies may not be so well defended, it may be worthwhile for the ladybird to stay and assess the situation and decide whether to remain still and hope to continue feeding or to flee. Wichmann (1955) suggested that Coccinellidae are adapted to attacking ant-tended colonies by keeping still when molested. It is also interesting to note that different species appear to be treated differently by the ants, some being attacked more violently than others. Our observations suggest a number of differences in the interactions between *M. ruginodis* and different ladybird species. These should be investigated further.

The ant response results show an increased level of ant hostility after the ladybird has been found on the colony and for about 2 minutes after it has left the colony. This result was suported by observational evidence; for example, on the colony tended by *L. niger*, after the ladybird had been found on the plant, the ants would sometimes all leave the colony to search for the ladybird, for several minutes. This was the only time we saw the colony untended during the day.

There could be a number of explanations for these observations; a pheromonal messenger, causing the increase in hostility, could be released either by the ants which encounter the ladybird or by the aphids themselves. This could either be released into the air, in which case it might take several minutes for levels to fall below a threshold value sufficient to stimulate the ants; or it could be released directly onto the ladybird, in which case the formic acid used by the ants is a possible candidate. The latter should seem less likely as the effect seems to be a more general increase in ant activity rather than a specific increase in hostility to the ladybird. This needs to be tested experimentally.

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BOOK REVIEW

The Lepidoptera by Malcolm J. Scoble. Natural History Museum Publications/Oxford University Press, 1992, ISBN 0-19-854031-0, 404 pages (4 colour plates and 321 figures and black and white photographs) £45, hardback.—A glance around the "natural history" section of any book shop will reveal a wide range of books on bufferflies and moths. Most, if not all, will be identification guides, although a few will have some pages on other matters such as their ecology and structure. There has, until now, been a noticeable lack of any up to date book on the form, function and diversity of the Lepidoptera. This void has been filled with the publication of M. Scoble's *The Lepidoptera* (earlier volumes in the series have been published on the Hymenoptera and Hemiptera).

The book's text is divided into three sections. The first part deals with the form and function of the external lepidopteran morphology, i.e. the head, thorax and abdomen, followed by chapters, on the same subject matter, on the ova, larvae and pupae, with the concluding chapter on "hearing, sound and scent". The initial chapters describe the morphology of each body section and their associated structures, followed by a detailed description of the function of the structures. I would recommend that any reader with a passing interest in the Lepidoptera, reads Chapter 2, which deals with the insect's head and amongst other things, feeding mechanisms and habits. The reader's attention should focus on the feeding habits of the Noctuid genus *Calyptra*. This genus includes species which feed on fruit by piercing the skin and one species, *C. eustrigata*, which feeds on mammalian blood. A fascinating description is given of the piercing mechanism, which is apparently confined to the males.

The wings are given extensive treatment in Chapter 3 "The adult thorax", as is proper considering their importance. Their function is discussed in great detail. The

use of the wings is foremost, for flight, although the way in which the insects couple and fold their wings as well as the use of the venation in classification is also examined. The secondary use of the wings involves their coloration. Their uses in defence/camouflage, mimicry, attraction and thermoregulation are also considered. The short section on mimicry was especially pleasing as it put a complex subject into a page and a half of understandable text. The chapter on the ova, larvae and pupae, something which most other publications barely mention, was most welcome.

The final chapter of this section deals with communication by sound and scent. I would have thought that all lepidopterists were aware of the use of pheromones for attracting the opposite sex. I wonder how many realize that sound is also used for the same effect.

The second section of the book deals with the environmental importance of the Lepidoptera including their use as indicators of environmental change.

The final section provides a guide to the major taxa starting with a short chapter on the historical development of lepidopteran classification; followed by four chapters dealing with the superfamilies of (i) primitive Lepidoptera, (ii) early Heteroneura, (iii) lower Ditrysia and (iv) higher Ditrysia. Each superfamily is broken down to family level with brief descriptions of the adult stage, immature stages, biology and classification. Those lepidopterists who like myself, until now, considered that the "Rhopalocera" constituted the Hesperiodea and Papilionoidea, will be surprised to find the addition by the author (back in 1985) of a further superfamily, the Hedyloidea. Black and white photographs of typical members of each family are reproduced at the end of Chapter 12.

Should the reader wish to pursue a particular subject matter there are copious references to other works throughout the book. These are catalogued in the usual manner, in an extensive reference list at the end.

There are a few typographical errors and inconsistencies in the book. For example at page 168 under "Pheromones and speciation" *Colias philodice* and *C. eurytheme* are mentioned. In the following sentence they are referred to as *P. philodice* and *P. eurytheme*. At page 102 reference is made to the presence of a cloaca being present in many Trichoptera. The next sentence states that a cloaca is not present in the Trichoptera. Page 117 in the last sentence of the first paragraph of "Coverings of the body" should I believe read "Unlike primary setae . . ." and not "Unlike secondary setae . . .". Finally figure 9 on plate 1 refers to the species figured as *Strymonidia w-album*. That shown is not the Palaeartic species it is supposed to be.

However, these very minor points do not detract from an excellent and well-written book. The approach taken by the author has produced a book which is both easy and enjoyable to read. It is a book I would certainly recommend to all entomologists, not just lepidopterists, who wish to broaden their knowledge of the order's general biology and diversity. The book would make a useful addition to any entomologists' library.

M. J. SIMMONS

Corrigendum—I should like to point out that Mr D. B. Wooldridge of 'Pictou', Church Street, Niton, Isle of Wight, captured the aberration of *Hypsopygia costalis* (F.) photographed at the 1992 BENHS Annual Exhibition (*Br. J. Ent. Nat. Hist.* 1993; **6**: Plate III). I exhibited the specimen on his behalf.—S. A. Knill-Jones, Roundstone, 2 School Green Road, Freshwater, Isle of Wight.

THE RHODODENDRON LACEBUG, *STEPHANITIS RHODODENDRI* HORVATH, REDISCOVERED IN SOUTH-EAST LONDON

RICHARD A. JONES

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Charged with obtaining some live specimens of the brightly coloured rhododendron leafhopper, *Graphocephala fennahi* Young, for a BBC television programme, I was initially at a loss to know where some suitable rhododendron bushes might be growing in the immediate neighbourhood. Mr Peter Sibley, Southwark Council's borough ecologist, helpfully suggested the aptly named 'Rhododendron Garden' in Dulwich Park, London SE21 (vice-county 17, 'Surrey').

On a visit to the park on 23.vii.1993, *Graphocephala fennahi* was present in thousands, every sweep of the net disturbing a great cloud of them to circle round and land back on the plants nearby. As one part of a bush was disturbed, the jumping of the insects could be heard distinctly, a soft 'tick' as each leapt into the air; the vast numbers combining to produce a rustling series of clicks. However, the most interesting find of the day was the discovery of several specimens of the rhododendron lacebug *Stephanitis rhododendri*, swept from the first bush examined.

A further visit to Dulwich Park on 9.ix.1993, with Mr Peter Hodge, proved the insect to be still present, and quite common on several bushes. It might be interesting to report that the bug was difficult to find using a beating tray, but could be swept from some of the higher branches using a net (the rhododendron bushes in the park are very large, many being over 5 metres tall). Whether this reflects the preferred position of the insect, almost out of reach on the upper limbs of the bushes, is difficult to determine; certainly *Graphocephala* seldom landed on the beating tray, because it took to the air almost immediately as it fell, to fly off without being seen. It seems unlikely that the lacebugs were flying off quickly; they moved slowly and delicately on their long legs.

Graphocephala fennahi and *Stephanitis rhododendri* are introduced species, both being native to North America. But whereas *Graphocephala* is now almost ubiquitous on British rhododendrons (Dolling, 1991), *Stephanitis* has had different fortunes. After it was first recorded as British (Distant, 1910), *Stephanitis* became quite common and widespread over much of England and Wales (Blair, 1948). This initial spread led to some fears from nurserymen, but in recent years it has declined, leading some to suggest that it may even have died out (Dolling, 1991; Judd & Rotherham, 1992). Southwood (1985) commented on the dramatic disappearance of this species, as did Kirby (1987), and since Allen found it in Blackheath in 1960 (Allen, 1962), no recent records have been reported until this year when the bug turned up in an Oxfordshire garden (Campbell, 1993).

Two other introduced rhododendron bugs were also present in Dulwich Park. *Kleidocerys resedae* (Panz.) (Lygaeidae) was very common. Although it is a native British species, the rhododendron-feeding form, first recorded in 1952, is thought to be an introduced North American subspecies (Southwood & Leston, 1959). A few specimens of the introduced European leafhopper *Placotettix taeniatifrons* (Kirschb.) (Cicadellidae) were also present on 9.ix.1993.

The Rhododendron Garden in Dulwich Park was laid out at the end of the 19th century and contained thousands of bushes of many species, varieties and races. At present the park is being surveyed in an attempt to identify the species surviving 100 years later and to compare these with the planting lists from the inception of the gardens. This (unpublished) survey by Mr Brian Wurzell suggests

that many bushes are likely to be *Rhododendron ponticum* L. in their original form, likewise *R. augustini* L., but many appear to be hybrids.

It is interesting that the garden has sometimes been referred to as the 'American Garden', because of the large number of North American plants laid out there. Documents in the Greater London Record Office contain planting lists of many thousands of plants, including, for example, a consignment of 'American plants' received on 4.xii.1890 from Messrs W. Cutbush & Son of Highgate Nurseries: "3200 rhododendron seedlings in various colours 1½–2 feet, 1000 azaleas—hardy in various colours . . ." and so on, detailing over 10,000 specimens of herbaceous plants, bushes and trees. Is it any wonder that American insect species such as *Graphocephala fennahi* and *Stephanitis rhododendri* became established in Britain at this time?

Acknowledgements

My thanks are due to Peter Sibley, ecologist for the London Borough of Southwark, for his advice in sending me off to Dulwich Park, and to Celia Cronin of the same department for supplying details of the current survey and original planting lists.

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ANNOUNCEMENT

A new book offer—The butterflies of Kent.—Just over ten years ago, the Kent Field Club, the natural history society of Kent, published *An atlas of the Kent flora* giving detailed distribution maps of 2000 or so flowering plants and ferns to be found in Kent. The Society subsequently decided to embark on a similar scheme to map the distribution of the county's butterflies.

The results have now just been published in the Society's journal in the form of a book entitled *The butterflies of Kent, an atlas of their distribution* written by Eric Philp. The book (60 pp) contains colour photographs, black and white illustrations, accounts and detailed "dot" distribution maps of the various species to be found in Kent.

The book is now on sale at £6 a copy but is available at a special price of £5.00 including post & packaging until 28 February 1994 (payable to the Kent Field Club, c/o The Hon. Secretary, Mr K. Palmer, 62 Judd Road, Tonbridge, Kent TN9 2NJ).

THE BRITISH EPERMENIIDAE

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This is a small family, which was often placed in the superfamily Yponomeutoidea, but which has recently been placed in its own superfamily (Schnack, 1985; Scoble, 1991). The family contains approximately 100 species world-wide, 25 in Europe and eight in the British Isles. The European species were revised by Gaedike (1966) who illustrates the genitalia of all species. He recognizes four genera in two subfamilies, one genus and subfamily being absent from Great Britain (*Ochromolopsis* in the Ochromolopinae).

All species feed on the leaves or seeds of plants in the families Apiaceae or Santalaceae. The only British member of the Santalaceae is the bastard toadflax, *Thesium humifusum* DC., the food plant of *Epermenia insecurella*; all the other British species attack Apiaceae. However, other European species attack Santalaceae and, if one accepts the classification of Gaedike as an evolutionary hypothesis, there must have been at least three host plant switches between the two families. The Apiaceae and Santalaceae are not closely related and we shall argue elsewhere that a more parsimonious classification can be constructed that involves only a single switch in food plant family. If this suggestion is correct then the original food plants for the family were in the Santalaceae and there has been a secondary radiation on the Apiaceae.

The British moths in this family are between 8 and 15 mm in wingspan and appear superficially similar to acrolepiines or gelechiids. *Epermenia* spp. and *Phaulernis dentella* have well-developed scale teeth on the dorsum: tufts of scales that give the moth, when at rest, a ridgeback appearance. It is possible that further species in this family remain to be discovered in Great Britain. For example, it would be worth checking spun seeds of *Peucedanum officinale* L. for the central European species *Cataplectica dentosella* (Herrich-Schäffer).

Phaulernis dentella (Zeller), Plate V, Fig. 1

Wingspan 9–10 mm. Forewings nearly unicolorous, in fresh specimens with indistinct lighter patches. Larva with dark brown head and yellowish body with darker lines. Feeds in July and August in spun seeds of *Chaerophyllum temulum* L. (= *C. temulentum*), *Pimpinella* spp., *Aegopodium podagraria* L. and perhaps other Apiaceae. The moth overwinters as a pupa and flies in June when it can be found on sunny days on the flowers of its food plant. Widespread but local in Southern England from East Anglia to Cornwall.

Phaulernis fulviguttella (Zeller), Plate V, Figs 2 and 3

Wingspan 10–11 mm. Thorax and forewing ground colour fuscous with an orange head and orange spots on wings. Specimens from the Shetlands (and the Alps) are larger with heavier spotting (Fig. 3) and were once separated as *auromaculata* Frey. Larva with dark brown head and whitish body with raised grey spots and a brownish subdorsal line. Feeds in spun seeds of *Heracleum sphondylium* L. and *Angelica sylvestris* L. between September and October. Overwinters as pupa, the moth flying in July and August when it can be found resting on its foodplant. Widespread and locally common throughout the British Isles.

Cataplectica farreni Walsingham, Plate V, Fig. 4

Wingspan 9–10 mm. Forewing ground colour fuscous with whitish spots which may coalesce to form an indistinct fascia. Larva with brown head and pale yellow body with darker, interrupted subdorsal lines. Feeds within individual seed capsules of *Pastinaca sativa* L. and perhaps other Apiaceae from August to September. The moth flies in June and July. Rare, though perhaps overlooked, recorded from the South Midlands, East Anglia and Aberdeenshire.

Cataplectica profugella (Stainton), Plate V, Fig. 5

Wingspan 8–10 mm. Forewing unicolorous brown with a bronze sheen in fresh specimens. Larva with black head and prothoracic plate and dirty creamy-yellow body with a wide, dull purplish-pink dorsal band and indistinct sublateral bands. Feeds within the spun seeds of *Daucus carota* L., *Pimpinella saxifraga* L., *Angelica sylvestris* L. and *Aegopodium podagraria* L. between September and October. Overwinters as pupa, the moth occurs in July and August when it can be found flying around the foodplant in early evening sunshine. Local throughout England from the Isle of Wight to Northumberland, often found on downlands.

Epermenia illigerella (Hübner), Plate V, Fig. 6

Wingspan 12–14 mm. Forewing ground colour ochreous-fuscous with darker infuscations, especially distally. The cilia are white-tipped except near the apex which gives the wing a subfalcate appearance. There are two or three scale teeth on the dorsum. Larva with orange-brown head and yellow-green body with a darker dorsal line. Bivoltine, the first generation feeds in May and June in the spun leaflets of *Angelica sylvestris* L. and *Aegopodium podagraria* L. The second generation feeds in August on the same foodplants, either in the umbel or in the floret stem beneath. The moth flies in June and July and again in August and September. Fairly common in England from the Midlands southwards.

Epermenia insecurella (Stainton), Plate V, Fig. 7

Wingspan 9–11 mm. Forewing ground colour white with a variable amount of grey scaling that coalesces to form an indistinct fascia and a dark subterminal area. There are also two small black dots on disc and up to five ochreous patches on disc and dorsum. Dorsum of forewing with two scale teeth. Larva with black head and yellowish body with brownish dorsal and subdorsal lines. Bivoltine, feeds in April and May and again in July on *Thesium humifusum* DC., the young larva feeding in full-depth mines in the leaves and also in the petiole; older larva feeding externally. Larvae in the second generation feed on flowers and unripe seeds. The moth flies in May and June, and a second generation in July and August. Local and rare in central-southern England and infrequently observed in recent years. Though possibly under-recorded, it is absent from several localities where its foodplant is common.

Epermenia chaerophyllella (Goeze), Plate V, Fig. 8

Wingspan 12–13 mm. A variable species, the forewing colour from creamy-white to fuscous. An indistinct fascia is visible on lighter specimens with more extensive infuscation distally as well as ochreous patches, especially at three quarters. In darker specimens, the whole wing is more or less infuscate though an ochreous patch at three quarters is normally visible. Cilia white-tipped except near apex so that wing appears subfalcate. There are three or four black and ochreous scale teeth. Larva with pale brown head and yellowish body with a whitish dorsal line and black or brown spots. Feeds on *Heracleum sphondylium* L., *Pastinaca sativa* L., *Anthriscus sylvestris* (L.) Hoffm.,

Angelica sylvestris L., *Daucus carota* L. and probably other Apiaceae. When young, the larva mines the leaves from the underside in short, squat mines, expelling the frass in mounds at the entrance to the mine. Later feeding on the underside of the leaf, often gregariously, in a slight web and producing 'windows' in the leaf. Found from mid-May to September in two or three overlapping generations. Overwinters as an adult, the moth can be found in all months of the year but is most frequent from October to May and in July and August. The most abundant member of the family, found throughout the British Isles.

Epermenia aequidentellus (Hofmann), Plate V, Fig. 9

Wingspan 9–12 mm. Forewing narrower than congeners. Ground colour variable, normally light fuscous with areas of darker infuscation, especially medially and in terminal areas, though in some specimens the ground colour is creamy-white or the infuscation much heavier. There are four dark scale teeth on dorsum. Larva with black head and prothoracic plate and yellow-green body with black or brown spots and darker dorsal line. Feeds in May and June and again in August and September on *Daucus carota* L. and *Pimpinella saxifraga* L., at first in a small blotch mine and then later feeding externally in a slight web. The moth flies in June and July, and the second generation in September and October. Local in Central-southern and South-west England, found most frequently near the coast.

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ANNOUNCEMENT

Subscription changes—Following the decision taken at the Special Meeting on 14th September the distinction between 'Ordinary' and 'London' members has ceased and a unified system of subscription has been adopted.

The rates of subscription that will apply from 1st January 1994 and for at least four years, payable on or before that date, will be:

Ordinary & Corporate Members	£12.50
Junior Members	£4.00
Life Members	£500.00

With effect from this change it will be possible for members to covenant their subscriptions and I would urge you to do this if you are a tax payer. Subscriptions paid under covenant will be deemed to be paid net of tax and the Society will be able to reclaim the tax suffered. Covenanted subscriptions will cost you no more but will result in substantial benefit to the Society. A note of the covenant made should be retained to help in completing your personal income tax return.

Revised standing order forms and deeds of covenant were issued recently and I would ask that these could be returned as soon as possible to the Assistant Treasurer and in any case before 31st December. Prompt action on this will save the Society considerable work and expense.—A. J. Pickles, Treasurer.

PLATE V

1. *Phaulernis dentella*
Grays, Essex, 12.vi.1986,
D. Agassiz coll.

2. *P. fulviguttella*
Chiddingfold, * viii. 1935,
L. T. Ford (BMNH)

3. *P. fulviguttella*
* Shetland, 20.vii.1897,
p.pr. J. Salvage, Bankes coll. (BMNH)

4. *Cataplectica farreni*
Cambridge, vii.1894,
Bankes coll. (BMNH)

5. *C. profugella*
Riddlesdown, * vii.1943 on *Pimpinella*,
L. T. Ford (BMNH)

6. *Epermenia illigerella*
Stanmore, end viii.1946,
L. T. Ford (BMNH)

7. *E. insecurella*
* Swanage 14.vii.1885,
Bankes coll. (BMNH)

8. *E. chaerophyllella*
Bexley, 1.vii.1928,
L. T. Ford (BMNH)

9. *E. aequidentellus*
Mullion, * x.1947,
ex carrot per JMS, L. T. Ford (BMNH)

10. *Caryocolum alsinella*
Sandwich, 28.vi.1948,
L. T. Ford (BMNH)

11. *C. alsinella*
Suffolk, * vii.1932 per JWM,
L. T. Ford (BMNH)

12. *C. viscariella*
Bare, Lancs. vi.1941,
L. T. Ford (BMNH)

13. *C. viscariella*
Bare, Lancs. vi.1940,
L. T. Ford (BMNH)

14. *C. vicinella*
Portland, * *Silene maritima* mid vi.1938,
L. T. Ford (BMNH)

15. *C. marmoreum*
Oronsay, Argyll 21.vi.1978,
D. Agassiz coll.

16. *C. marmoreum*
Oronsay, Argyll 21.vi.1978,
D. Agassiz coll.

17. *C. fraternella*
Bexley, * *Cerastium* vi.1938,
L. T. Ford (BMNH)

18. *C. blandella*
Bexley, * *S. holostea* 1st week vii.1935,
L. T. Ford (BMNH)

19. *C. proximum*
Manu (*sic*) 1849
(BMNH)

20. *C. blandulella*
Sandwich, Kent * 12.vi.1982,
D. Agassiz coll.

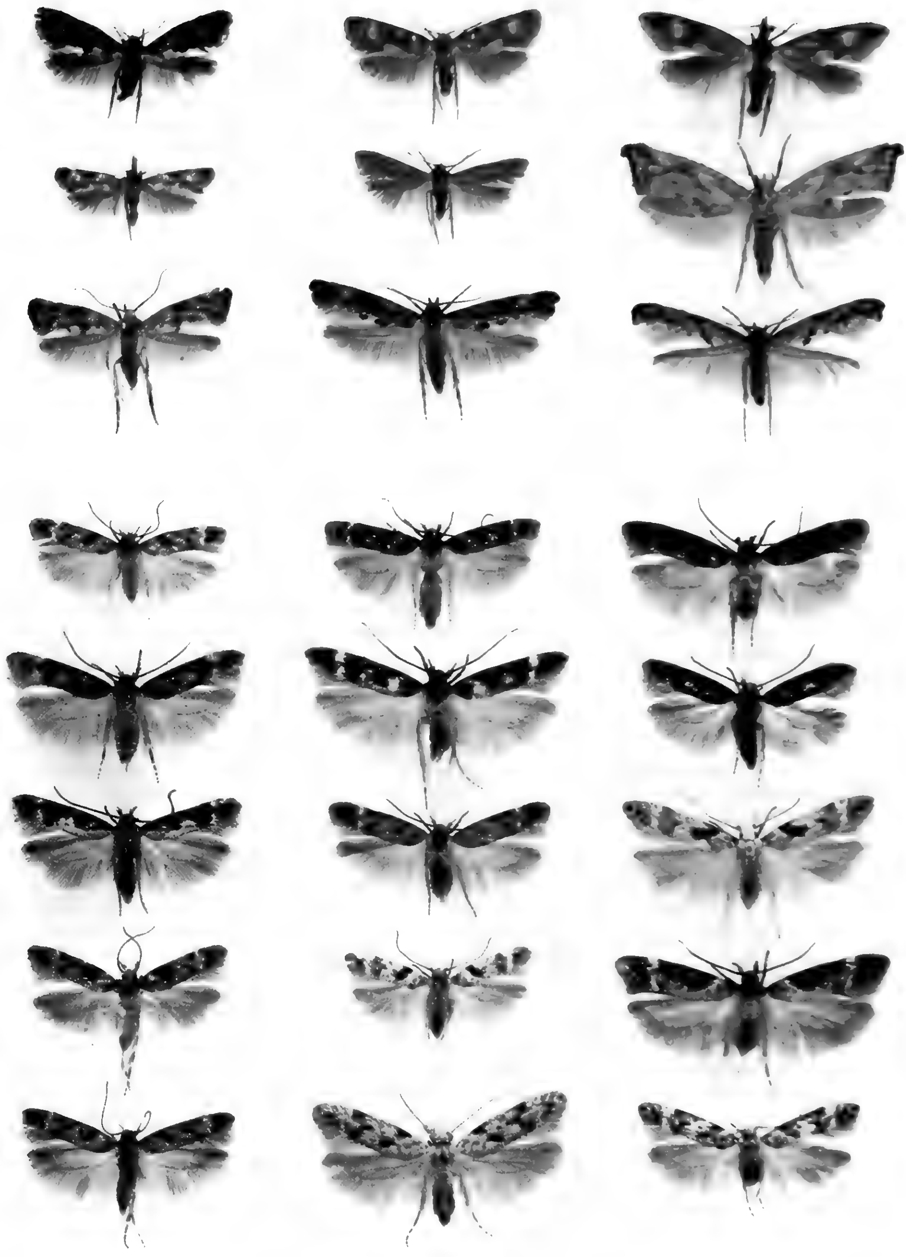
21. *C. tricolorella*
Bexley, 1st week vii.1932,
L. T. Ford (BMNH)

22. *C. junctella*
Silesia, Staudinger, 184 (?)
(BMNH)

23. *C. kroesmanniella*
Hofmann coll. (BMNH)

24. *C. huebneri*
Breslau, *Stell. holostea* vi.29,
Hofmann coll. (BMNH)

*indicates a bred specimen. Photo: G. B. Senior.



THE BRITISH SPECIES OF *CARYOCOLUM* GREGOR & POVOLNY

P. HUEMER

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The Gelechiid genus *Caryocolum* comprises nearly 70 species mainly distributed in the Palaearctic region with a few taxa in the Nearctic. Although the British fauna includes only 12 species, they have often been confused and misidentified in the past. Usually it is possible to distinguish the species by the wing pattern and colour, as well as the colour of head and thorax. Difficulties in determination arise because of the extraordinary variation of individual specimens. In many cases it is therefore essential to examine the genitalia for reliable results. The genitalia structures of the British *Caryocolum* are easily distinguishable by many characters except *alsinella* and *viscariella*. They were figured by Pierce and Metcalfe (1935) who used the standard method of genitalia preparation and arrangement. A technique similar to that recently described by Pitkin (1986) was used for the present study. This explains the difference in the appearance from the figures of Pierce & Metcalfe (1935).

Male and female genitalia of all the British species of *Caryocolum* are figured in this paper, although the aedeagi and signa are not shown.

Caryocolum species are univoltine and their larvae feed on various genera of Caryophyllaceae, for example *Cerastium*, *Stellaria*, and *Silene*. In Britain the life history of only one species (*junctella*) is not yet sufficiently known. Caterpillars are usually found in the spring, early instar larvae sometimes from December onwards. Moths are on the wing from late May into September, one species (*junctella*) hibernates as an adult.

KEY TO THE BRITISH SPECIES OF *CARYOCOLUM* (BASED MAINLY ON GENITALIA)

MALES

1 Sacculus almost completely reduced .... *fraternella*
—Sacculus well developed 2
2 Saccus slender to moderately broad 3
—Saccus extremely broad 11
3 Posterior margin of vinculum with medial and lateromedial incision; valva without apical brush of setae; aedeagus with minute cornuti 4
—Posterior margin of vinculum with medial incision; valva with apical brush of setae; aedeagus without cornuti 7
4 Sacculus broad rhomboidal, longer than valva; vinculum narrow . . *marmoreum*
—Sacculus not broad rhomboidal, shorter than valva; vinculum broad 5
5 Sacculus long .... *vicinella*
—Sacculus short 6
6 Forewing 4.0–5.0 mm .... *alsinella*
—Forewing 5.5–6.5 mm .... *viscariella*
7 Saccus slender 8
—Saccus with broad base 9
8 Sacculus with hook-shaped apex.. *junctella*
—Sacculus without hook-shaped apex.. *tricolorella*
9 Valva short, without apical bulge .... *blandulella*
—Valva long, with apical bulge..10

10 Valva comparatively long, slightly emarginated medially .... *blandella*
— Valva comparatively short, strongly emarginated medially .... *proximum*
11 Posterior margin of vinculum with broad, V-shaped emargination, without lateral process .... *huebneri*
— Posterior margin of vinculum with extremely broad, U-shaped emargination, long lateral process present .... *kroesmanniella*

Females

1 Eighth segment without folds or processes .... *fraternella*
— Eighth segment with folds or processes 2
2 Ductus bursae with pair of lateral sclerotizations posteriorly 3
— Ductus bursae without lateral pair of sclerotizations posteriorly 6
3 Eighth segment with pair of big, rounded sclerotizations .... *marmoreum*
— Eighth segment without rounded sclerotizations 4
4 Antrum funnel-shaped .... *vicinella*
— Antrum reduced 5
5 Forewing 4.0–5.0 mm .... *alsinella*
— Forewing 5.5–6.5 mm .... *viscariella*
6 Signum: big hook with additional teeth .... *junctella*
— Signum: moderately small to reduced hook, without additional teeth 7
7 Signum: distinct hook 8
— Signum: hook completely reduced .... *kroesmanniella*
8 Eighth segment with numerous narrow folds and microtrichia ventromedially .... *tricolorella*
— Eighth segment without narrow folds and microtrichia ventromedially 9
9 Eighth segment with pair of long digitate processes dorsally .... *blandella*
— Eighth segment with pair of digitate or flap-like processes ventrally 10
10 Ventromedial zone of eighth segment with sclerotized ovate plate . . *proximum*
— Ventromedial zone of eighth segment membranous 11
11 Processes of eighth segment long, digitate .... *blandulelella*
— Processes of eighth segment short, flap-like .... *huebneri*

Description of species

Caryocolum alsinella (Zeller, 1868), Plate V, Figs 10 and 11
semidecandriella (Tutt, 1887)
semidecandrella (Threlfall & Stainton, 1887)

Wingspan 8.5–11 mm. Head, thorax and tegulae mid-brown mottled with white, face white. Forewing whitish, flecked with mid-brown; black markings; broad patch from fold to costa at $\frac{1}{4}$, spots at $\frac{2}{5}$, $\frac{3}{5}$, the latter comma-shaped and extended towards dark brown tornus; markings usually surrounded by orange-brown scales; irregular orange-brown patch distal of cell; white costal and tornal spots at $\frac{4}{5}$ separated; forewing apex with patch of black scales.

Male genitalia (Fig. 1). Transtilla without spines. Valva long, slender, sword-shaped. Sacculus short, thumb-shaped, concave emargination distoventrally. Posterior margin of vinculum with deep medial, shallow lateromedial incision. Saccus long, slender.

Female genitalia (Fig. 13). Eighth segment without processes, two pairs of short ventromedial folds developed. Antrum reduced. Ductus bursae with pair of long lateral sclerotizations posteriorly. Signum with large, stout, strongly bent hook.

Remarks. There is considerable variation in the extent of orange-brown scales; specimens from Britain and Denmark exhibit more of these scales and have therefore been treated as a distinct subspecies (*semidecandrella*) in the past. Moths of a similar external appearance also occur in Southern Europe and so it seems unsatisfactory to give this form subspecific status. *C. alsinella* is very similar to *proximum* externally; it usually differs in the smaller black patch at $\frac{1}{4}$. It is distinguished from the similar *junctella* by the head and thorax which are not metallic shiny. The genitalia are extremely similar to those of *viscariella*. *C. alsinella* differs from the latter mainly in the smaller size and lack of orange-brown patches near the dorsum. It seems possible that *alsinella* and *viscariella* are conspecific, although the host-plants and larval feeding behaviour are different. Stainton (1867) illustrates the larvae of *viscariella* as green in colour, those of *alsinella* yellow (as *maculiferella*). According to the original description the colour of *alsinella* caterpillars is light green (Zeller, 1868). Benander (1965) gives the colour of the larva as yellow or green. Further research should be done to solve these discrepancies. Tentatively *alsinella* and *viscariella* are treated as two different species.

Biology. The larva is a leaf-miner in spring (Sønderup, 1949). Later it feeds on spun shoots, flowers and seed-capsules of *Cerastium semidecandrum* L. before it pupates in June (Stainton, 1867). On the Continent the larval stage has also been found on *Minuartia verna* (L.) Hiern (Zeller, 1868) and *Cerastium arvense* L. Adults have been collected from July to the middle of August, abroad from late June to early October. In Britain it inhabits sandy coasts.

Found locally on coasts of England, Wales and Scotland, not recorded from Ireland. Abroad in Europe and Morocco.

Caryocolum viscariella (Stainton, 1855), Plate V, Figs 12 and 13

Wingspan 12–14 mm. Head, thorax and tegulae mid to dark brown mottled with a few light scales, face white. Forewing mid to dark brown mottled with whitish; M-shaped dorsum lightened, flecked with orange-brown; indistinct black markings; broad patch from fold to costa at $\frac{1}{4}$, spots at $\frac{2}{5}$, $\frac{3}{5}$ and apex; irregular orange-brown patch distad of cell; white costal and tornal spots separated by orange-brown streak.

Male genitalia (Fig. 2). As described under *alsinella*.

Female genitalia (Fig. 14). As described under *alsinella*, differences in the figures compared with *alsinella* are as a result of individual variation.

Remarks (see also remarks on *alsinella*). The forewing colour of this species varies from distinctly marked to almost unicolorous dark brown. *C. viscariella* differs from the somewhat similar *vicinella* in the extent of orange-brown scales as well as in genital characters such as the shorter sacculus, the posterior margin of the vinculum and the reduced antrum. Small specimens of *viscariella* sometimes resemble *alsinella*, but they usually differ in the two orange-brown patches near the dorsum. The genitalia are indistinguishable from those of *alsinella* and therefore *viscariella* and *alsinella* could prove to be conspecific (see remarks on *alsinella*).

Biology. According to Bradford (1979) the larva occurs from April to June, feeding on a spun central shoot and living in the stem when not feeding. Bradford (1979) gives *Silene dioica* (L.), Clairv., *S. latifolia* Poiret (= *S. alba*) and *Lychnis viscaria* L. as host-plants. On the Continent the larva has been recorded also on *Silene vulgaris* Garcke (Lhomme, 1946). Moths have been collected from early July to the middle of August.

Local in England and Wales, having spread eastwards in a remarkable way in the early 1980s. Abroad throughout Europe except the south-west.

Caryocolum vicinella (Douglas, 1851), Plate V, Fig. 14

Wingspan 12.5–15 mm. Head, thorax and tegulae dark brown, face whitish-silvery. Forewing dark brown scattered with a few light scales; M-shaped dorsum whitish mottled with mid-brown, two wedge-shapes across cell at $\frac{1}{5}$, $\frac{1}{2}$ not reaching costa; white costal and tornal spots at $\frac{4}{5}$ always separated.

Male genitalia (Fig. 3). Transtilla without spines. Valva long, slender, sword-shaped. Sacculus long, broadening medially, concave emargination distoventrally. Posterior margin of vinculum with deep medial, shallow lateromedial incision; lateral lobes rounded. Saccus long, slender.

Female genitalia (Fig. 15). Eighth segment without processes, two pairs of long ventromedial folds developed. Antrum short, broad funnel-shaped. Ductus bursae with pair of long lateral sclerotizations posteriorly. Signum with large, stout strongly bent hook.

Remarks. *C. vicinella* sometimes resembles *viscariella* externally but is easily distinguishable by the lack of orange-brown scales. The genitalia are similar to those of *alsinella* and *viscariella*. They differ in the longer and broader sacculus, the posterior margin of the vinculum, the antrum and the distinctly longer apophyses posteriores (2.7 mm in *vicinella*, up to 2 mm in *alsinella/viscariella*). *C. vicinella* has often been misidentified as *leucomelanella* in the past. The latter species does not occur in Britain.

Biology. In Britain the larvae have been found in May and June, feeding within spun young shoots and boring into the new stem of *Silene uniflora* Roth (= *Silene maritima*) (e.g. Stainton, 1867). In Scandinavia it also lives on *Spergularia rubra* (L.) Presl. (Benander, 1928) and on the Continent on *Lychnis alpina* L. (Schütze, 1931) and *Cerastium arvense* L. (Pröse, 1979). Moths emerge from late June to mid-July and have been collected until the middle of September. The habitat of *vicinella* is pebbly shores. In the Alps it occurs on screes.

In Britain recorded locally on coasts throughout the British Isles, abroad throughout Europe, except the south.

Caryocolum marmoreum (Haworth, 1828), Plate V, Figs 15 and 16

Wingspan 9.5–12 mm. Head, thorax and tegulae light to dark brown, face whitish. Forewing mid to dark brown, dorsal margin greyish-white to mid brown; two triangular whitish patches across cell at $\frac{1}{5}$, $\frac{1}{2}$ surrounded by black dots, sometimes reduced; white costal and tornal spots at $\frac{4}{5}$ separated or forming a fascia.

Male genitalia (Fig. 4). Transtilla band-like, without spines. Valva slender, linear. Sacculus broad, almost rhomboidal, pointed apex, slightly exceeding valva. Posterior margin of vinculum with two pairs of projections, medial incisions and lateromarginal emargination. Vinculum short. Saccus long, slender.

Female genitalia (Fig. 16). Eighth segment without processes, a pair of large rounded sclerotizations; triangular sclerotizations ventromedially. Antrum reduced, ring-shaped. Ductus bursae with a pair of short lateral sclerotizations posteriorly. Signum with large, strongly curved hook.

Remarks. *C. marmoreum* exhibits considerable variation in the extent of the light forewing markings which are sometimes almost completely reduced, giving those specimens an almost unicolorous appearance. The colour of the head and thorax above shows the same range of variation. The genitalia are easily distinguishable from other British *Caryocolum* by many characters.

Biology. The larva and its life history were described in detail by Stainton (1867); larvae have been found from March into May, feeding on the leaves of *Cerastium fontanum* Baumg. The larval stage lives in a silken tube at the base of the host-plant, covered with grains of sand and it finally pupates in this tube. Moths have also

been bred from *Cerastium semidecandrum* L. in Britain (Walsingham, unpublished records), and *Silene nocteolens* on the Canary Islands (Klimesch, 1984). Adults have been collected from May to September and are undoubtedly univoltine. *C. marmoreum* occurs along sand dunes in Britain; abroad it also lives in pine forests in mountainous areas.

Common on coasts throughout Britain and in the Breck sand district of East Anglia. Abroad in Europe, Morocco, Canary Islands, Canada. Records from Scandinavia and the former USSR are probably misidentifications of *pullatella*.

Caryocolum fraternella (Douglas, 1851), Plate V, Fig. 17
intermediella (Hodgkinson, 1897)

Wingspan 11–13 mm. Head, thorax and tegulae light to dark brown, tegulae lighter distally. Forewing dark fuscous, orange-brown across $\frac{1}{5}$, $\frac{1}{2}$, patch at $\frac{3}{5}$; black spots distad of cell, the latter usually comma-shaped, extending towards tornus, black markings indistinct; white costal and tornal spots at $\frac{4}{5}$ separated by orange-brown streak.

Male genitalia (Fig. 5). Transtilla with a few spines. Valva broad, two processes distally. Sacculus almost completely fused with valva. Posterior margin of vinculum with two pairs of indistinct processes, jug-shaped emargination medially. Saccus moderately slender.

Female genitalia (Fig. 17). Eighth segment without processes. Antrum long, tubular. Hook of signum large, stout.

Remarks. *C. fraternella* differs from the externally similar *alsinella* by the extension of orange-brown scales and the separated costal and tornal spots. The male genitalia differ from all other *Caryocolum* in the reduced sacculus.

Biology. The larva feeds in a spun shoot from April to the end of May (Stainton, 1867). Bradford (1979) gives *Stellaria uliginosa* Murray (= *S. alsine*), *S. graminea* L. and *Cerastium fontanum* Baumg. (= *holosteoides*) as host-plants in Britain. Agassiz (pers. comm.) bred this species from *Cerastium arvense* L. On the Continent *fraternella* has been recorded from *Stellaria holostea* L. (Schütze, 1931). Moths have been bred from June to July. It inhabits rough meadows where *Stellaria graminea* grows; adults have been collected mainly in August.

Local in Britain, extending as far north as Dumfries. Abroad in France, Germany, Poland and Scandinavia.

Caryocolum blandella (Douglas, 1852), Plate V, Fig. 18
maculea sensu Haworth, 1828

Wingspan 12–14.5 mm. Head, thorax and tegulae white mottled with cream, base of thorax dark brown. Forewing whitish mottled with orange-brown, grey-brown along costa; black markings: broad streak from fold to costa at $\frac{1}{4}$, medial spots at $\frac{1}{2}$, $\frac{3}{5}$, the latter frequently divided; apex with black spots; white fascia at $\frac{4}{5}$ often separated by orange-brown scales.

Male genitalia (Fig. 6). Transtilla with numerous minute spines. Valva long, slender, with distinct apical bulge and brush of setae. Posterior margin of vinculum slightly vaulted medially with small incision. Saccus broad at base, gradually tapering.

Female genitalia (Fig. 18). Eighth segment with a pair of broad digitate processes dorsally, ventromedial zone with ovate plate. Antrum short, conical, indented. Posterior part of ductus bursae with sclerotized plate. Hook of signum slender.

Remarks. *C. blandella* bears a superficial resemblance to *blandulella*, *proximum* and *kroesmanniella*. It differs from the former two species in its larger size, from the latter in the more strongly contrasting forewing markings and the black streak at $\frac{1}{4}$ which is not interrupted. *C. proximum* is also distinguishable from *blandella*

by the darker head colour. The male genitalia of this species are somewhat similar to those of *proximum* but differ in the distinctly longer and broader valva and the broader uncus.

Biology. The larva feeds on *Stellaria holostea* L., in the early spring as a leaf-miner, later between spun shoots and finally within the seed capsules. It is fully grown in early June (Douglas, 1852; Stainton, 1867). Moths have been collected from early July to mid-September, particularly in deciduous forests.

Local in England, Wales and Ireland as far north as Cumbria. Abroad in Europe, except the southern part.

Caryocolum proximum (Haworth, 1828), Plate V, Fig. 19
maculiferella (Douglas, 1851)

Wingspan 9–11.5 mm. Head, thorax and tegulae mid-brown mottled with white, face white. Forewing whitish, densely speckled with mid- to grey-brown; black markings: broad patch from fold to costa at $\frac{1}{4}$, spots at $\frac{2}{5}$, $\frac{3}{5}$, the latter comma-shaped; indistinct white costal and tornal spots at $\frac{4}{5}$.

Male genitalia (Fig. 7). Transtilla with numerous minute spines. Valva moderately long, slender, with distinct apical bulge and brush of setae. Sacculus knife-shaped. Posterior margin of vinculum medially with small incision. Saccus broad at base, gradually tapering. Uncus narrow.

Female genitalia (Fig. 19). Eighth segment with pair of long digitate processes ventrally, ventral zone with large ovate sclerotization. Antrum short, funnel-shaped, indented. Signum with short, stout hook.

Remarks. *C. proximum* is similar to *junctella*, *alsinella* and *blandulella* externally. It differs from *junctella* in the colour of the head and thorax, from British *blandulella* in the extent of dark fuscous scales and the broad black patch at $\frac{1}{4}$, a marking in which it also differs from *alsinella*. The male genitalia are similar to those of *blandella* although they may be distinguished by the distinctly shorter and more slender valva and the narrower uncus as well as by the shape of the saccus. The female genitalia differ from those of *blandulella* in the ovate ventromedial plate of the eighth segment.

Biology. According to Bradford (1979) the larva occurs in May and feeds on the flowers and seeds of *Cerastium fontanum* Baumg. On the Continent it has also been bred from *Stellaria media* (L.) Vill. (Karsholt, 1981). Records of *Cerastium semidecandrum* L. as a host-plant (Stainton, 1867) refer to *alsinella*. Moths have been collected from late June to the middle of September, frequently during August. Most specimens have been collected near open grassland flying around hawthorn hedges.

Local in England and Wales to Durham. Abroad in Europe, except the south-west, Scandinavia, USA.

Caryocolum blandulella (Tutt, 1887), Plate V, Fig. 20

Wingspan 8.5–11 mm. Head, thorax and tegulae white flecked with a few mid-brown scales. Forewing whitish mottled with grey-brown, particularly along costa and dorsal margin; black markings: broad patch from fold to costa at $\frac{1}{4}$, spots at $\frac{2}{5}$, $\frac{3}{5}$, the latter, occasionally comma-shaped spot is sometimes extended towards tornus; black patch apically; white costal and tornal spots at $\frac{4}{5}$ forming indistinct fascia.

Male genitalia (Fig. 8). Transtilla with numerous minute spines. Valva short, without distal bulge, apical brush of setae present. Sacculus short, broad, with pointed apex. Posterior margin of vinculum with V-shaped emargination. Saccus broad at base, gradually tapering.

Female genitalia (Fig. 20). Eighth segment with pair of digitate, flap-like processes ventrally, ventral zone membranous. Antrum a short funnel. Signum with moderately short hook.

Remarks. Specimens from the Danish islands and the Swedish island of Øland are characterized by distinctly darker forewings which are covered by numerous fuscous-tipped scales. This form is not known from Britain. *C. blandulella* is similar to *blandella* externally but differs in its smaller size. It is distinguishable from *proximum* by the smaller black patch at $\frac{1}{4}$ and the paler forewing. The female genitalia are similar to those of *proximum* but differ in the membranous ventromedial zone of the eighth segment.

Biology. The larva has been found feeding on *Cerastium semidecandrum* L. in Britain (Agassiz, pers. comm.). Benander (1965) records the caterpillar in the seed capsule of *Cerastium pumilum* Curt. in Sweden. Moths occur from the middle of July to late August, particularly along sandy coasts.

Very local in Britain, being known only from two localities in Kent and Hampshire. Abroad throughout central Europe to Greece.

Caryocolum tricolorella (Haworth, 1812), Plate V, Fig. 21
contigua (Haworth, 1828)

Wingspan 12–14.5 mm. Head dark grey-brown, face white. Thorax and tegulae grey-brown, mesoscutellum lightened. Forewing: basal quarter and dorsal margin orange-brown, flecked with white; third quarter with irregular orange-brown patch, white costal and tornal spots at $\frac{4}{5}$, broad black patch from fold to costa at $\frac{1}{4}$, and apex.

Male genitalia (Fig. 9). Transtilla with minute spines. Valva long, slender, slightly broadened distally with apical brush of setae. Sacculus knife-shaped, pointed. Vinculum with almost straight posterior margin, small incision developed. Saccus stout, gradually tapering.

Female genitalia (Fig. 21). Eighth segment with pair of small flaps dorsally, ventral zone with numerous microtrichia. Antrum moderately short, funnel-shaped. Signum with large hook.

Remarks. *C. tricolorella* usually differs from the other British *Caryocolum* species in the three-coloured forewing pattern.

Biology. The young larva makes a gallery-like mine in a leaf of *Stellaria holostea* L. In Britain it occurs from December onwards; later it feeds in a spun terminal shoot. It is fully grown about mid-April (Stainton, 1867). Sorhagen (1886) gives *Stellaria uliginosa* Murray (=*S. alsine*) as an additional host-plant on the Continent. Moths have been collected from June to mid-September.

Local in England and Wales. Abroad in Europe, except the south-west.

Caryocolum junctella (Douglas, 1851), Plate V, Fig. 22

Wingspan 9.5–11 mm. Head, thorax and tegulae dark grey-brown metallic, face silvery shiny. Forewing whitish mottled with grey-brown, particularly across wing at $\frac{1}{5}$, $\frac{1}{2}$ and along dorsal margin; black markings: patch from fold to costa at $\frac{1}{4}$, stripe distad of cell extending towards tornus, apical dot; orange-brown patch distad of cell, scales along fold; indistinct white fascia at $\frac{4}{5}$ occasionally interrupted.

Male genitalia (Fig. 10). Transtilla with numerous spines. Valva slender, slightly broadened distally with apical brush of setae. Sacculus with hook-shaped apex. Vinculum short, straight posterior margin slightly incised medially.

Female genitalia (Fig. 22). Eighth segment short, pair of dorsal flaps developed, ventral zone with numerous microtrichia. Antrum long, tubular. Signum with very long hook, some short teeth basally.

Remarks. *C. junctella* differs from similar species like *blandulella*, *proximum* and *alsinella* in the metallic shiny neck and the pale frons. Additionally it is recognizable by the distinct orange-brown patch of the forewing.

Biology. The life history in Britain is not yet known. In Sweden the larva has been found on *Cerastium arvense* L. (Benander, 1928), in China on *C. pauciflorum* (Liu & Pai, 1979). The larval stage has also been noted from *Stellaria* (Klimesch, 1954). As far as is known, *junctella* is the only *Caryocolum* species which hibernates as an adult. Moths have been collected in April/May and in July/August.

Local and scarce in north-west England, Scotland and Kent. Abroad in Europe, China and Japan.

Caryocolum huebneri (Haworth, 1828), Plate V, Fig. 24
knaggsiella (Stainton, 1866)

Wingspan 9–12.5 mm. Head, thorax and tegulae mid- to dark-brown mottled with white, face white. Forewing mid-brown mixed with whitish, light brown, orange-brown; black markings: broken fascia from fold to costa at $\frac{1}{4}$, medial spots at $\frac{1}{2}$, $\frac{3}{5}$, the latter extending towards tornus; apex dark fuscous; white costal and tornal spots at $\frac{4}{5}$ usually separate.

Male genitalia (Fig. 11). Tegumen with long lateral process; spines of transtilla almost completely reduced. Valva thumb-shaped. Sacculus short, almost triangular. Posterior margin of vinculum with broad V-shaped emargination. Saccus extremely broad, distally rounded.

Female genitalia (Fig. 23). Eighth segment with pair of flap-like ventromedial processes. Antrum tubular, moderately short. Signum with short, slightly bent hook.

Remarks. *C. huebneri* closely resembles *kroesmanniella* externally. It differs mainly in the smaller wingspan (9–12.5 mm compared with 12.5–15 mm in *kroesmanniella*) and the mottling of the thorax and forewing.

Biology. According to Bradford (1979) the larva has been found in May, feeding between spun shoots of *Stellaria holostea* L. Moths have been collected from the middle of July to late August, bred material dates from mid-June to late July.

Scarce and local in Britain, being recorded only from Surrey and west Kent. Abroad in Europe, except the south-west.

Caryocolum kroesmanniella (Herrich-Schäffer, 1854), Plate V, Fig. 23

Wingspan 12.5–15 mm. Head, thorax and tegulae whitish mottled with grey-brown and orange-brown. Forewing whitish mottled with light brown, orange-brown; black markings: broken fascia from fold to costa at $\frac{1}{4}$, medial spots at $\frac{1}{2}$, $\frac{3}{5}$, the latter extending towards dark brown tornus; apex with a few black spots; indistinct white fascia at $\frac{4}{5}$.

Male genitalia (Fig. 12). Tegumen with long lateral process; spines of transtilla almost completely reduced. Valva and sacculus slender, digitate. Posterior margin of vinculum with extremely broad rectangular emargination, large triangular process laterally. Saccus extremely broad, hardly narrowing distally.

Female genitalia (Fig. 24). Eighth segment with pair of drop-shaped processes dorsally, ventral zone membranous. Antrum long, funnel-shaped with a few microtrichia medially. Signum a small plate, without hook.

Remarks. This species exhibits considerable variation in the composition of the forewing colour. It is very similar to *huebneri* externally but differs in the large size and the usually paler forewing with less contrasting markings. *C. kroesmanniella* differs from the occasionally similar *blandella* in the interrupted fascia at $\frac{1}{4}$.

Biology. The larva starts feeding as a leaf-miner in the autumn. After hibernation it lives in spun shoots until May (Benander, 1965). It usually feeds on *Stellaria holostea*

L. but has also been found on *S. uliginosa* Murray (= *S. alsine*) (Klimesch, 1954) and *S. media* (L.) Vill. (Süssner, 1966) on the Continent. Moths have been caught in open woodland from early July to the beginning of September.

Scarce and local in England north of Gloucestershire. Abroad in Europe, except the southern part.

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I am most grateful to David Agassiz for his advice and valuable comments and to Dr Klaus Sattler for information and loan of material. Furthermore I am indebted to the late E. C. Pelham-Clinton and P. A. Sokoloff for remarks on the manuscript and distribution data. The genitalia photographs were taken by the Photographic Unit of the BM(NH).

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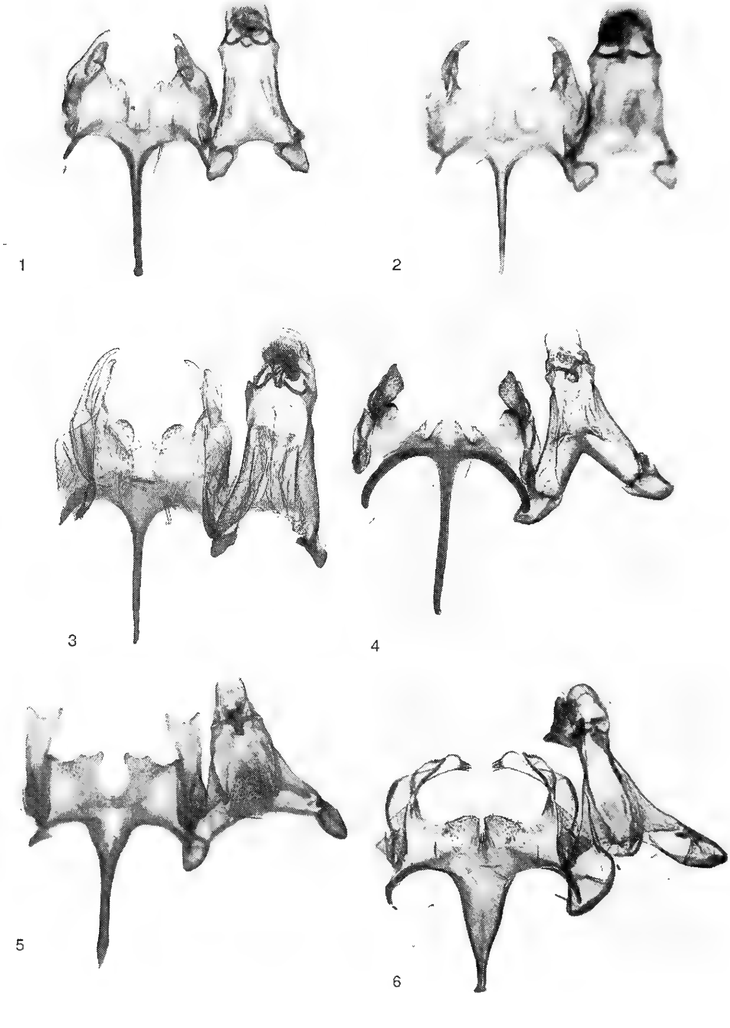
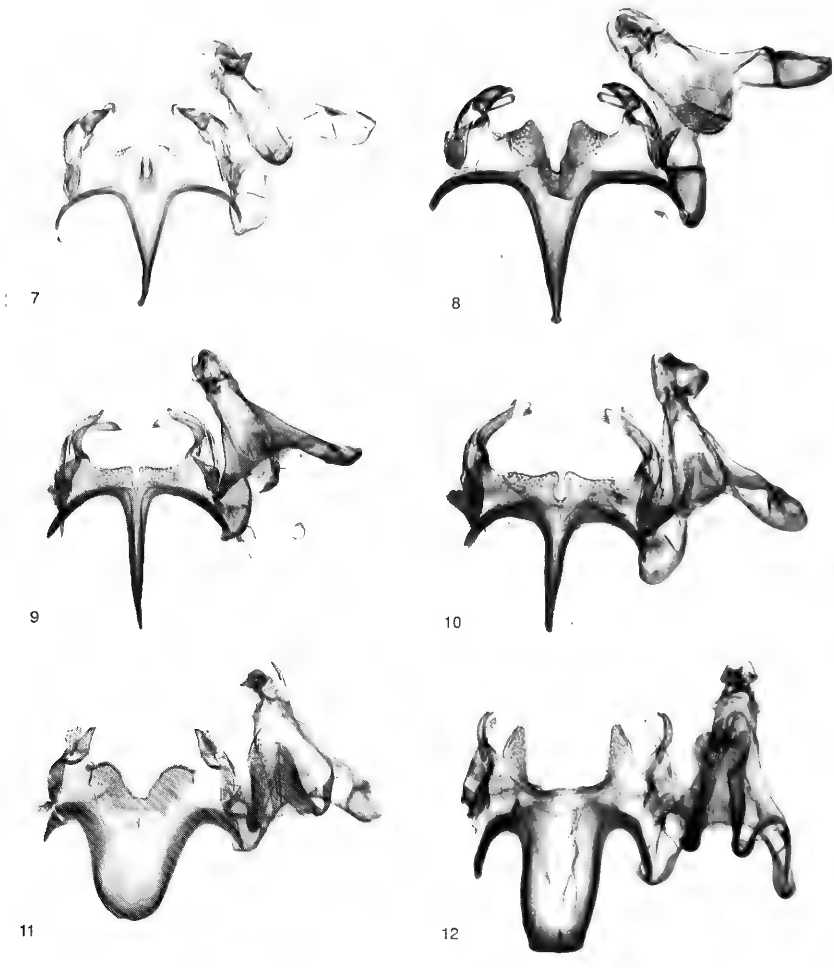
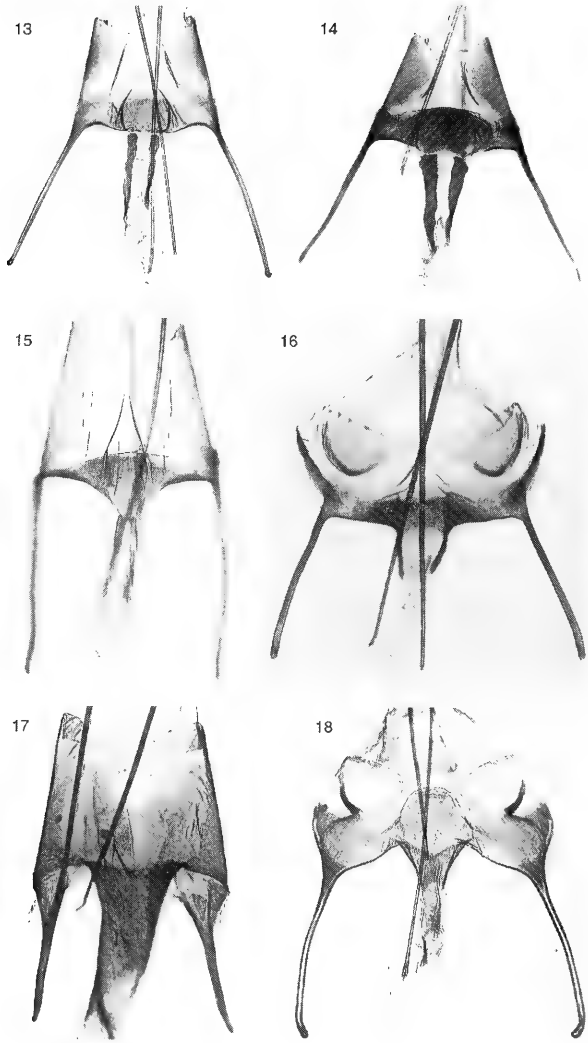


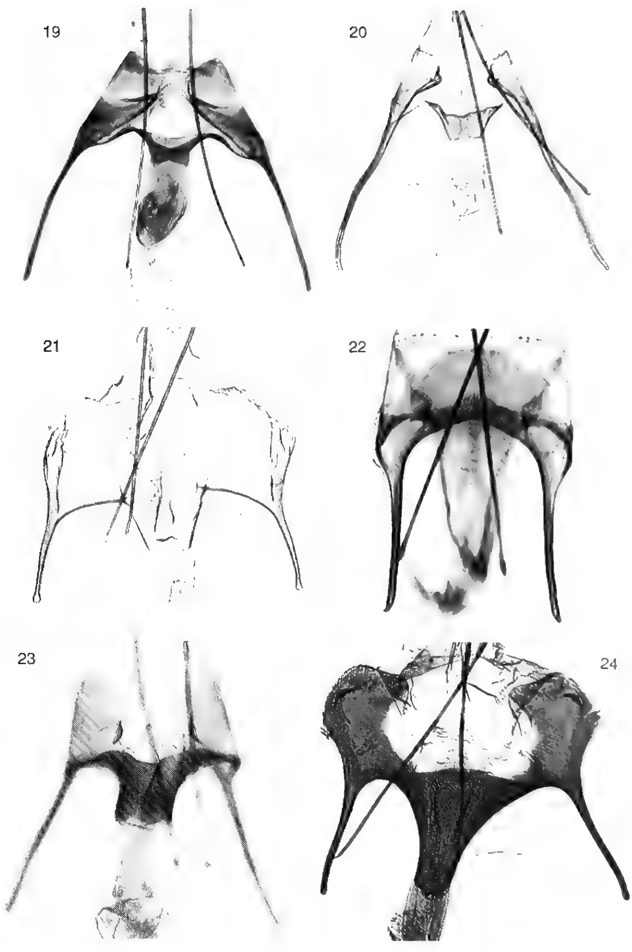
Figs 1–6. Male genitalia of British *Caryocolum* species. 1: *C. alsinella*, 2: *C. viscariella*, 3: *C. vicinella*, 4: *C. marmoreum*, 5: *C. fraternella*, 6: *C. blandella*.



Figs 7–12. Male genitalia of British *Caryocolum* species. 7: *C. proximum*, 8: *C. blandulella*, 9: *C. tricolorella*, 10: *C. junctella*, 11: *C. huebneri*, 12: *C. kroesmanniella*.



Figs 13–18. Female genitalia of British *Caryocolum* species. 13: *C. alsinella*, 14: *C. viscariella*, 15: *C. vicinella*, 16: *C. marmoreum*, 17: *C. fraternella*, 18: *C. blandella*.



Figs 19–24. Female genitalia of British *Caryocolum* species. 19: *C. proximum*, 20: *C. blandulella*, 21: *C. tricolorella*, 22: *C. junctella*, 23: *C. huebneri*, 24: *C. kroesmanniella*.

BOOK REVIEW

Woodland rides and glades: their management for wildlife by M. S. Warren and R. J. Fuller and **Coppiced woodlands: their management for wildlife** by R. J. Fuller and M. S. Warren, Peterborough, Joint Nature Conservation Committee, 1993, 2nd edns, 32 pages and 34 pages respectively, paperback, £3.50 each.—These two booklets, aim to provide a prescriptive guide to habitat management for wildlife in a readily accessible form to the site manager or reserve warden. For some unknown reason, researchers into wildlife management, including myself in the past, have the habit of publishing in relatively obscure journals or conference proceedings; these authors have thankfully collated the information into a digestible form.

Both booklets contain historical backgrounds on their subjects. The origins of coppicing go back several thousand years, the cyclical cutting producing wood products for building and burning, as well as 'cottage' industries such as basket or hurdle making. Open grassland areas have existed in woodlands since the retreat of the last ice flows, formed naturally at first, but increasingly created by mankind for grazing stock or hay.

Management history has an important influence on wildlife interest, as the booklets describe. Coppicing creates open, hot woodland, allowing for example, particular butterflies to thrive whilst preventing the establishment of a substantial dead wood fauna. Woodland rides, even within an ecologically dull conifer plantation, may be valuable as linear unimproved hay meadowland, containing flora once common before widespread agricultural intensification.

The value to wildlife of coppicing and ride management is well covered and there are good colour photographs to illustrate techniques and beneficiaries. The consequences of cessation of management could not be better described than through relating the decline of the heath fritillary, *Mellicta athalia* (Rott.) to the abandonment of coppicing in southern England. Dozens of sites in the early part of this century have been reduced to a handful today. However, I appreciate the authors' caution in placing reintroduction of coppicing into a wider woodland management perspective, rather than acting on impulse to a rare butterfly crisis. Clear management objectives are required to look after woodland wildlife, since different species can have conflicting needs. In addition, simply because coppicing has ceased, it does not mean that the wildlife interest has died as well. Derelict coppice usually has a considerable standing dead wood component, a fine habitat for rare and beautiful microlepidoptera such as *Oecophora bractella* (F.), as I found recently in an abandoned oak coppice in Hampshire.

The booklets have plenty of facts and figures on management prescriptions. Whilst I did find them somewhat scattered throughout the explanatory text, there are some useful line drawings and illustrations which summarize current thinking on good management practice.

These two booklets are aimed at site managers. However, they are valuable to the amateur wishing to contribute to knowledge of wildlife management. They are highly readable and I would hope they could spur recorders into focusing their minds on how ride management and coppicing affects their pet interests, be they Coleoptera or Collembola.

If I have one criticism of the booklets, it is that there are no county-based lists of where good management systems are in operation to direct visits by interested recorders and managers. Otherwise, at £3.50 each, these two booklets are excellent value and useful texts.

P. H. Sterling

A REVIEW OF THE BRITISH OPOMYZIDAE (DIPTERA)

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The acalyptrate family Opomyzidae has about 50 species in four genera worldwide, found mostly in the Holarctic. They are small, yellow to dark-brown flies with at least the apex of the wing clouded in most species and often with other wing spots. Vockeroth (1987) provides a full family description. The larvae feed within the stems of Gramineae and a few species are pests of cereals and rye-grass ley in Britain and other parts of Europe and in Russia (Balachowsky & Mesnil, 1935; Nye, 1958).

The Palaearctic catalogue (Soós, 1984) lists nine *Opomyza*, eighteen *Geomyza* and the single species in a third genus, *Anomalochaeta guttipennis* (Zett.). Since then, another nine *Geomyza* and one *Opomyza* have been described (Nartshuk 1984, 1992, 1993; Drake, 1992; Carles-Tolra, 1993). Most of these species were described or re-described by Czerny (1928) who also provided a nearly comprehensive key to the Palaearctic fauna. Collin (1945) provided a key to thirteen then known from Britain, and to these Andrewes (1964) added *G. angustipennis* Zett. and Drake (1992) described *G. subnigra*. Vockeroth (1961) pointed out the presence of two species under "*combinata*" of Collin (1945) and these are now known to be *balachowskyi* Mesnil and *hackmani* Nartshuk. Sixteen species are therefore included in the present paper.

Several papers have catalogued the opomyzids found in individual countries in Europe or Russia, sometimes including keys (e.g. Hackman, 1958; Trojan, 1962; Stackelberg, 1970; Martinek, 1978a; Greve, 1981; Nartshuk, 1993). These authors illustrated the genitalia of some species but a number remain unfigured. The chaetotaxy of both genera is remarkably uniform so that keys place strong emphasis on wing pattern and coloration but relatively little on morphology. However, the genitalia, especially those of *Geomyza*, are often distinctive, and their examination is sometimes essential for identification.

Existing keys, especially that of Collin (1945), have provided the main characters used in the following key which has been arranged so that, as far as possible, common species are placed towards the beginning within each genus. This paper uses the names as currently understood and does not constitute a taxonomic revision. Only a few type specimens have been seen and all the figures except one are of British specimens. McAlpine (1981) has been followed for morphological terminology; refer to Fig. 4d. Unpublished records on distribution and dates of capture have been collected by the author. Dimensions are given in Table 1.

KEY TO THE BRITISH SPECIES

1 Wing with well developed alula and small anal vein; basal and apical setae of the scutellum approximately equal in size; arista pubescent. Predominantly yellow or greyish yellow, medium to large (for the family) flies .... *Opomyza*, 2

—Wing without alula or anal vein; apical setae of the scutellum long, the basal pair very short; arista short plumose (in British species). Mostly small to medium-sized flies with moderately shiny black abdomens and black, reddish or yellow thoraxes .... *Geomyza*, 7

2 Costal margin darkened beyond vein R_1. Pleura with brown marks. Middle femora of males with dense posteroventral bristles (*germinationis* group) 3

—Costal margin clear except for apical spot. Pleura entirely yellow. Middle femora of males simple. (*florum* group) 4

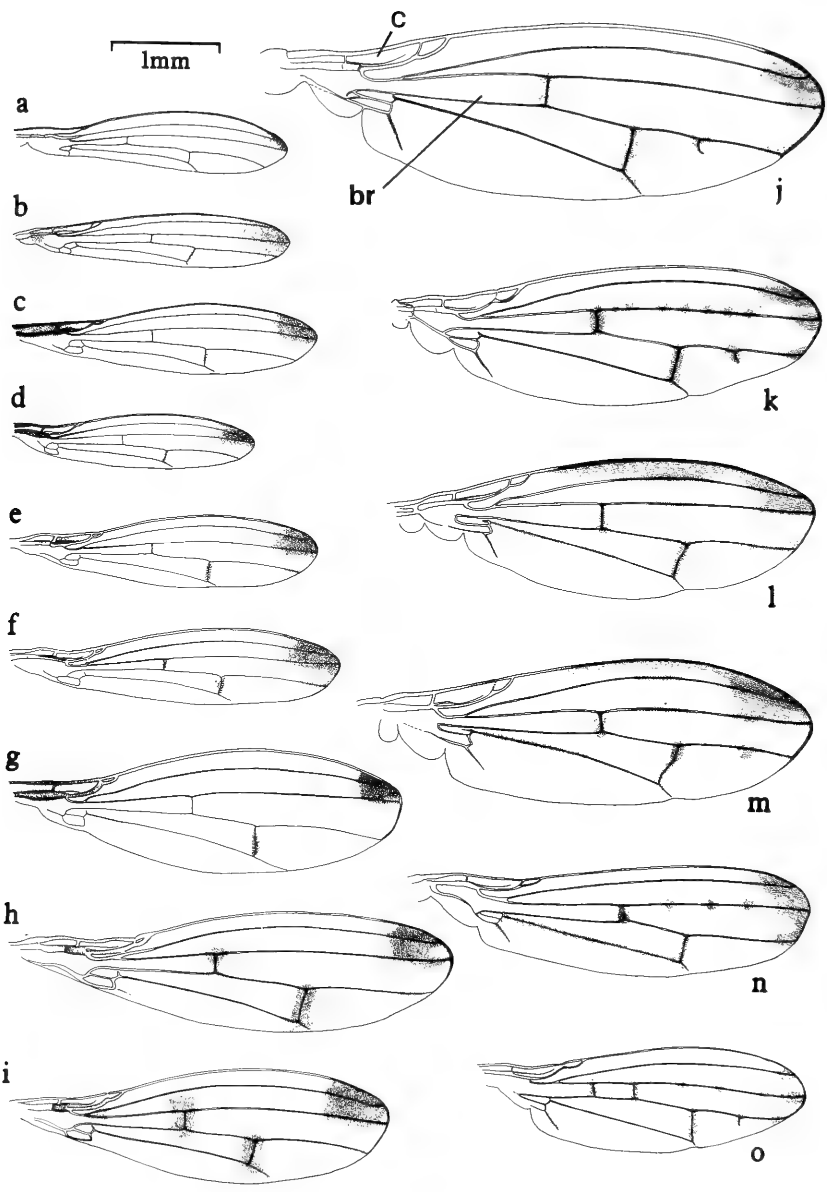

Fig. 1. Wings of British Opomyzidae. a: *Geomyza angustipennis*; b: *G. apicalis*; c: *G. subnigra* d: *G. breviseta*; e: *G. balachowskyi*; f: *G. hackmani*; g: *G. venusta*; h: *G. majuscula*; i: *G. tripunctata*; j: *Opomyza florum*; k: *O. punctata*; l: *O. germinationis*; m: *O. petrei*; n: *O. lineatopunctata*; o: *O. punctella*. Names of cells: c—costal, br—basal radial.

3 Abdomen dark with rounded dull yellow patches at the sides of each tergite, often ill-defined. Proepisternum without setulae midway between the coxa and postpronotal lobe (do not confuse with setae on the anterior edge of these lobes, cf. Fig. 4g). Dorsal setae on last abdominal segment of the male short, weak and placed midway along the segment so that they do not extend beyond the segment; male cerci evenly curved in lateral view, ending in a flattened point, without tiny black spines (do not confuse with tips of the surstylar lobes) (Fig. 2a). Tip of ovipositor ends above the median line in lateral view, the upper and lower halves not being symmetrical images (Fig. 5b)................*O. germinationis* (L.)

—Tergites yellow with dark central and lateral stripes, the central stripe never spreading sideways along the posterior margins of the tergites. Proepisternum with several setulae midway between the coxae and postpronotal lobe (Fig. 4g). Dorsal setae on the last tergite of the male long, placed near to its tip and extending well beyond the segment; cerci strongly angled in lateral view, ending in a blunt tip with numerous short black points (Fig. 2b). Upper and lower halves of the ovipositor are almost symmetrical images so that it appears rounded and blunt (Fig. 5c)*O. petrei* Mesnil

4 Wings with only four distinct dark marks comprising an apical spot, one on each crossvein and one midway along the last section of vein M (Fig. 1j). (The last section of vein R_{4+5} may be slightly clouded but this does not form a distinct spot) ....*O. florum* (F.)

—In addition to the four wing marks, there are distinct round spots either along the last section of vein R_{4+5} or in the basal radial cell before the r-m crossvein (Figs 1k, n, o)..5

5 Thorax with a dark central stripe. Vein CuA_1 and the adjacent membrane conspicuously dark (Fig. 1n)........................*O. lineatopunctata* von Roser

—Thorax without a dark central stripe. Membrane adjacent to vein CuA_1 virtually clear 6

6 Vein R_{4+5} without any spots or extra crossveins proximal to the r-m crossvein; apical spot continuous between the ends of the long veins, even if only faintly so (Fig. 1k). Prosternum (between the front coxae) with numerous setae. (Apart from extra spots on the last section of R_{4+5} this species resembles *florum*) ....*O. punctata* Haliday

—Vein R_{4+5} with clouds, with or without underlying extra crossveins, in the basal cell behind the first section of R_{4+5}; apical spot comprising separate clouds on the ends of R_{2+3} and R_{4+5} (Fig. 1o). Prosternum with about three setae on either side..*O. punctella* Fallén

7 Wing with large conspicuous dark spots on both crossveins (Figs 1h, i). Acrostichal setae in 6–8 rows at the level of the transverse suture.....................8

—Any shading on the crossveins is weak and restricted compared with the apical spot, and usually not extending appreciably beyond the long veins (Figs 1 a–g). Acrostichal setae in 4, or sometimes 6, rows at the level of the suture 9

8 Anepimeron with one strong seta in addition to 1–2 weak setae (Fig. 4f). Wing usually with a distinct spot at its base, spreading from near the end of R_1 and covering the fork of R_{2+3} and R_{4+5} but if faint then at least the extreme base of R_{4+5} itself is darker at the fork than on most of its length (Fig. 1i). Surstylar lobes slender with a straight posterior margin in lateral view; cerci extend almost to the ends of the lobe (Fig. 4a). Sternite 8 of female terminalia entire (Fig. 5j) ....*G. tripunctata* Fallén

—Anepimeron with 3–5 setulae only (Fig. 4e). No discernible spot covering the tip of R_1 and the fork of R_{2+3} and R_{4+5} and the veins here not darker than on most of their length (Fig. 1h). Surstylar lobes large and broadly rounded with a curved

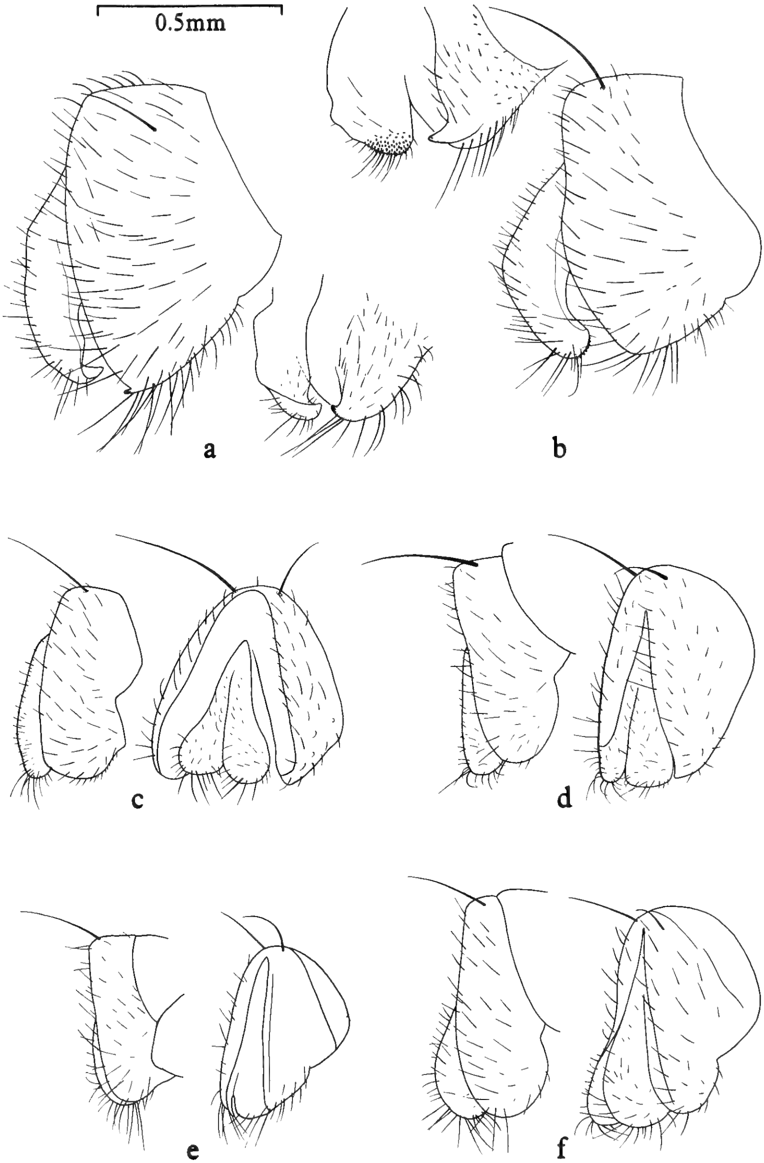

Fig. 2. Male genitalia of *Opomyza* species, lateral and posterolateral views (only the tips of the surstylar lobes are shown postero-laterally for a and b); a: *O. germinationis*; b: *O. petrei*; c: *O. florum*; d: *O. punctata*; e: *O. punctella*; f: *O. lineatopunctata*.

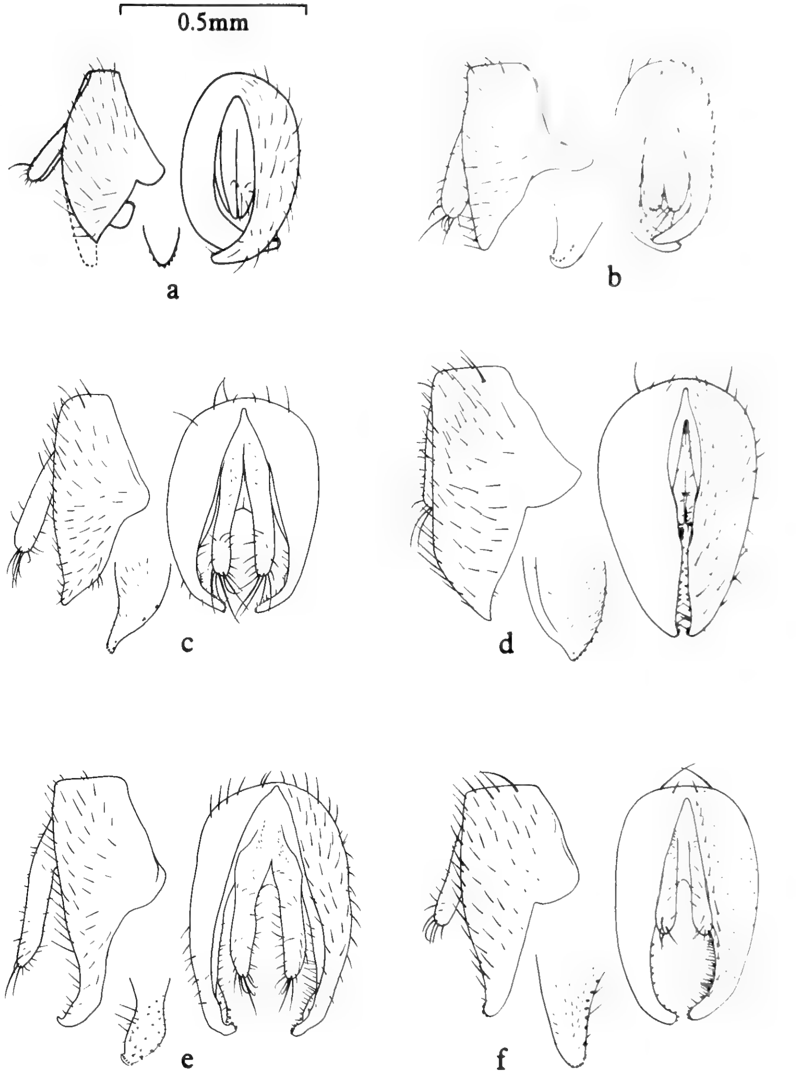

Fig. 3. Male genitalia of *Geomyza* species, lateral and posterior views and inner face of the tip of the surstylar lobe. a: *G. angustipennis*; b: *G. apicalis*; c: *G. balachowskyi*; d: *G. breviseta*; e: *G. hackmani*; f: *G. subnigra*.

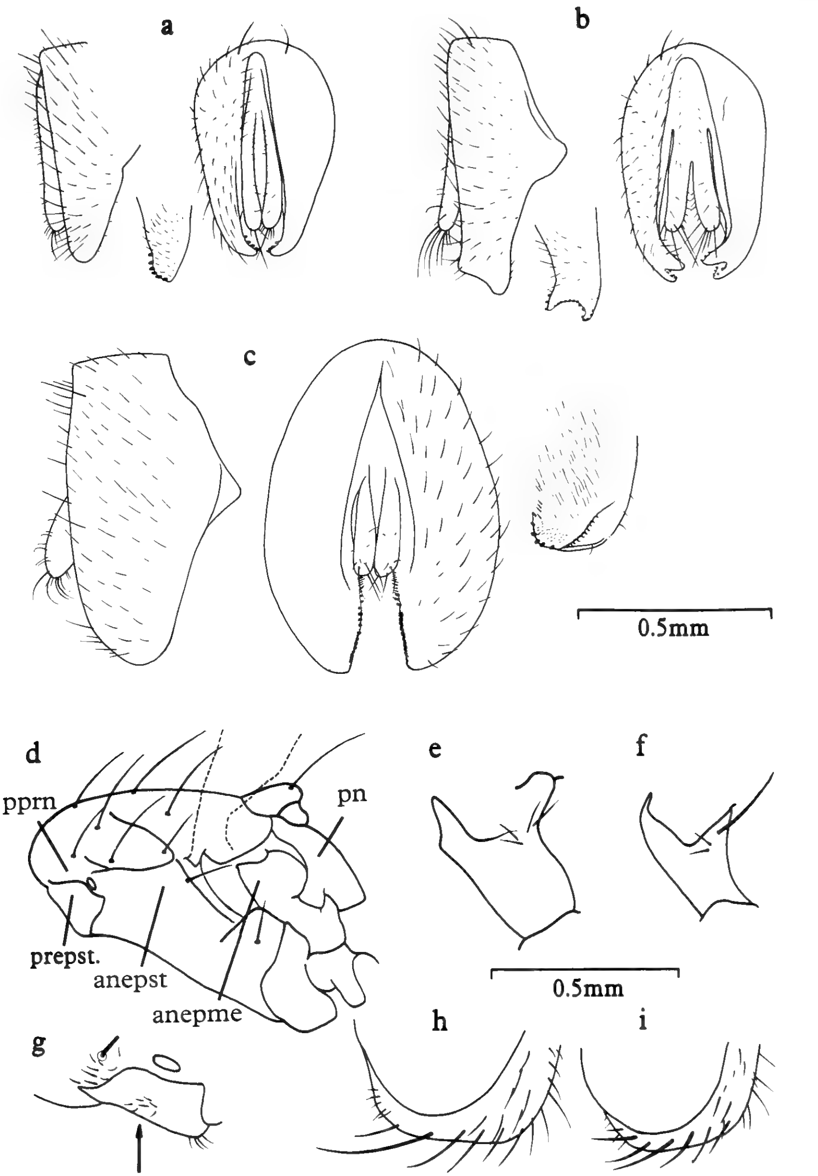

Fig. 4. (a–c) Male genitalia of *Geomyza* species. a: *G. tripunctata*; b: *G. venusta*; c: *G. majuscula*. d: Thorax of *Geomyza* showing location of proepisternum (prepst), anepimeron (anepme), postnotum (pn), anepisternum (anepst), postpronotal lobe (pprn). e: Anepimeron of *G. majuscula*. f: Anepimeron of *G. tripunctata*. g: Proepisternum of *Opomyza petrei*. h: Lower part of head of *G. apicalis* showing subvibrissal setae; i: the same for *G. subnigra*.

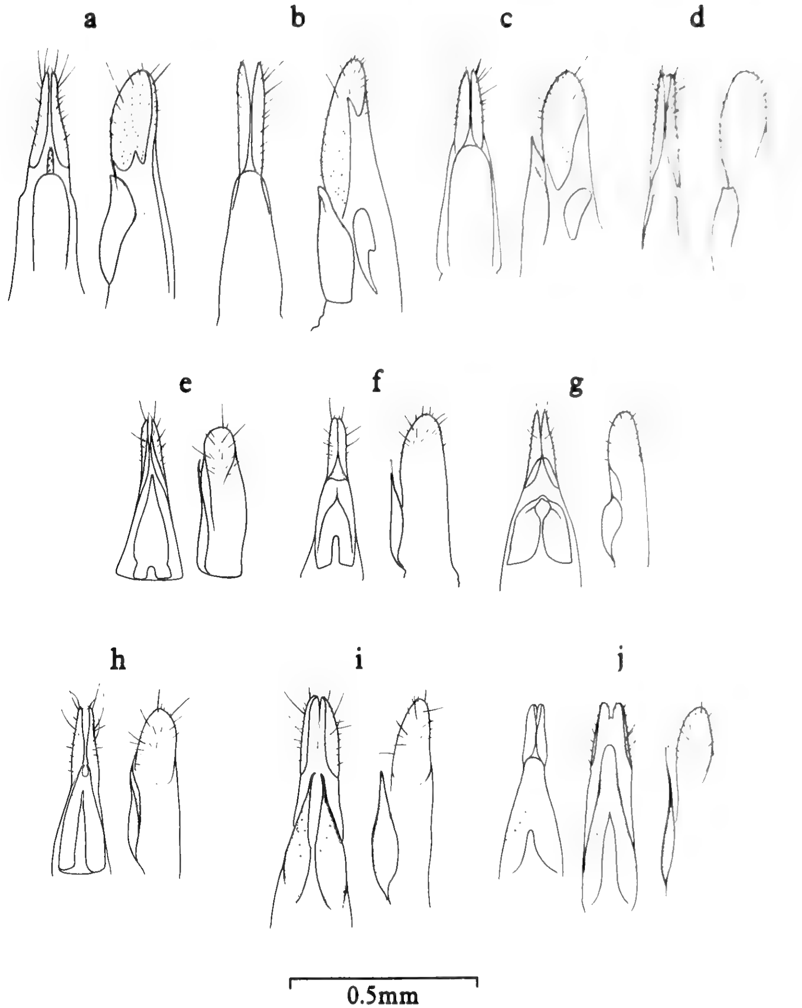

Fig. 5. Ovipositor of some *Opomyza* and *Geomyza* species, ventral and lateral views. a: *O. florum*; b: *O. germinationis*; c: *O. petrei*; d: *O. lineatopunctata*; e: *G. subnigra*; f: *G. breviseta*; g: *G. balachowskyi* (?); h: *G. venusta*; i: *G. majuscula*; j: *G. tripunctata*, showing two variations in ventral view.

lower posterior margin in lateral view; cerci short, extending to about two thirds of the depth of the lobes (Fig. 4c). Sternite 8 of female terminalia divided medially (Fig. 5i) .... *G. majuscula* Loew

9 One pre- and three postsutural dorsocentral setae (the first postsutural may be small or absent in *apicalis* which keys out in both halves of this couplet). Thorax pale, yellow to orange 10

—One pre- and two post-sutural dorsocentral setae. Thorax pale or dark 13

10 Apical spot large and extending well behind vein M; wings narrow, their width 17–23% of their length (Fig. 1b). First postsutural dorsocentral seta about half or less the length of the presutural dorsocentral seta .... *G. apicalis* (Meigen)

—Apical spot of the wing not extending behind vein M, or if so then only faintly; wings broader, their width very rarely less than 23% of their length measured to the root (Figs 1e–g). First postsutural dorsocentral seta not much smaller than the presutural dorsocentral seta 11

11 Surstylar lobes shallowly bifurcated at the tips (Fig. 4b). Thorax yellow, often with a distinct reddish tinge along the notopleura and top of each anepisternum, and usually with dark brown marks outside of the postsutural dorsocentral setae; postnotum dark. Crossvein r-m pale though may be surrounded by a faint cloud; length of the apical wing spot short, usually less than twice the length of the r-m crossvein; wings broader, their width about 28–33% of their length (Fig. 1g) .... *G. venusta* (Meigen)

—Surstylar lobes of males with simple-ended tips. Thorax more or less uniformly yellow; postnotum pale or dark. Crossvein r-m dark and surrounded by a small dark cloud; length of the apical wing spot obviously twice or more the length of the r-m crossvein; wings narrower, their width usually about 23–28% of their length 12

12 Tips of the surstylar lobes terminate in an inwardly directed finger-like extension (it is essential to get a clear view of the tip) (Fig. 3c). Postnotum yellow, or at least more similar in colour to the rest of the thorax than to the abdomen. Females are not separable.............................. *G. balachowskyi* Mesnil

—Tips of the surstylar lobes curved backwards with a slightly expanded rectangular end (Fig. 3e). Postnotum obviously darker than the rest of the thorax in all male specimens seen.................................. *G. hackmani* Nartshuk

13 Thorax dark brown. No subvibrissal seta is markedly stronger than any other (Fig. 4i).. 14

—Thorax orange or yellow. A strong subvibrissal seta may or may not be present (Fig. 4h) 15

14 Male surstylar lobes evenly tapered in side view and curve inwards at the tips in posterior view; cerci normal in size, clearly visible between the lobes and reaching well below the middle of them (Fig. 3f). Anterior part of thorax with very little pale or reddish colour, nearly all distinctly blackish-brown and lacking metallic reflections. Costal cell darkened. Sternite 8 of female terminalia tapered to a point (Fig. 5e) .... *G. subnigra* Drake

—Lower part of the surstylar lobes evenly convex in posterior and lateral view, leaving a narrow more or less parallel gap between them; cerci very small, hardly reaching halfway down the lobes and scarcely projecting from between them (Fig. 3d). Anterior part of the thorax often distinctly chestnut-coloured with slight metallic reflections on the paler parts of the pleura. Costal cell almost clear. Sternite 8 of female terminalia truncate with a transparent semicircular extension (Fig. 5f) .... *G. breviseta* Czerny

15 No strong subvibrissal seta; all are weak (Fig. 4i) .... *G. angustipennis* ....Zetterstedt

—One subvibrissal seta is stronger than the others (Fig. 4h) .... *G. apicalis* ....(Meigen) and *G. hendeli* Czerny

Opomyza florum (F., 1794). Only *O. punctata* can be confused with *florum*. It is one of the largest of the British opomyzids. Its thorax, and often the abdomen, is entirely yellow although there are often small brown lateral spots on the abdomen

which may darken in dried specimens. The last section of vein R_{4+5} may be infuscated and this must not be confused with the separate spots of *punctata*. The species typifies the group of closely related species which have very similar genitalia in both sexes and the males of which have middle tibiae with simple chaetotaxy.

It is widespread in Britain and sometimes common in lowland areas but scarce in western pastureland. It is a serious pest of wheat, barley and *Lolium* in Europe and Russia (e.g. Slope, 1957) but the wild hosts are not known. Thomas (1933) describes the life history. There is one generation per year. The eggs are laid on the soil close to the base of a wheat stem in autumn and probably overwinter in this stage, unlike nearly all other opomyzids studied which overwinter as third instar larvae. The eggs hatch in spring, the larvae pupariate within the tillers in May and the first adults emerge in early June. They are long-lived and move away from the fields into woodland and hedgerows until October when they mate and return to lay their eggs in arable fields. This account agrees with the dates of records which extend from the beginning of June to early November with most occurring from August to mid-October.

Opomyza germinationis (L., 1758). There is a strong possibility that some of the specimens in the Linnaean collection were muddled at some time because there is a specimen of what we know as *O. germinationis* masquerading as the type specimen of *Geomyza combinata* and the type specimen of *germinationis* is a species of *Palloptera* (Brian Cogan, pers. comm.). Linnaeus's description of *Musca germinationis* fits the species now known by this name rather better than the *Palloptera* or those in the *combinata* group. Although *germinationis* is the type species of the genus *Opomyza* Fallén, it would be prudent to retain the name *Opomyza* in the currently accepted sense rather than attempt to redefine the genera *Opomyza* and *Geomyza* on the basis of the Linnaean types.

The characters used in couplet 2, together with the form of the genitalia, separate *germinationis* and *petrei* into a group that is clearly different from the remaining, predominantly yellow, British *Opomyza*. The abdominal pattern of occasional specimens of *germinationis* may resemble that of *petrei* but then the central stripe extends at least partly along the hind margins of the tergites, thus breaking up its outline. In doubtful cases, the other key characters will separate them. Of many hundreds of specimens examined, only one *germinationis* had several distinct proepisternal setulae. A similar *Opomyza* from eastern Europe and Russia is *thalhammeri* Strobl which differs from *germinationis* (and *petrei*) in having a completely shining black abdomen and the costal shading starting beyond the level of crossvein r-m. Two Macquart species, *fuscipennis* and *fasciata*, may be synonymous with *germinationis* as they are not mentioned in Soós (1984) and no-one but Czerny (1928) and Séguy (1934), neither of whom had evidently seen these species, makes reference to them.

Opomyza germinationis is probably one of the commonest British flies, being found in a wide range of habitats throughout the country including Orkney. It is univoltine, the eggs being laid usually near the base of the stems of host plants or on the soil in early September to early November, the larvae overwintering mostly in the third instar, pupating in May and emerging in June (Thomas, 1934). The larvae feed within the stems of many species of common grasses (Thomas, 1934; Nye, 1958).

Opomyza lineatopunctata von Roser, 1840. This unmistakeable small yellow fly is the only one in the *florum* group with a thoracic stripe. Rarely, there are extra small spots, with or without underlying crossveins, proximal to crossvein r-m, as in *punctella*.

The ovipositor differs from those of the other British *Opomyza* in sternite 8 being truncate and slightly indented (Fig. 5d). Two other European species also have a dark central stripe on the thorax: *nigriventris* Loew has an almost black, shiny abdomen and is not known from western Europe, and *decora* Oldenberg, known only from Italy, lacks the spots on the distal section of vein R_{4+5} and cell r_{4+5} is somewhat darkened.

There are records from Kent, Sussex, Surrey (Allen, 1965), Berkshire, Somerset (Drake & Godfrey, 1989), Cambridgeshire, Suffolk, Norfolk, Salop, Cheshire, S. Yorkshire, Lancashire, Cumbria, Argyll, and all Welsh counties. The majority of the records come from bogs, heaths and fens. Although the fly has not been reared, there is strong circumstantial evidence that the host plant is *Molinia caerulea* (L.) Moench as this was the dominant grass at many of the localities. In Czechoslovakia, Martinek (1978a) has also swept it from pure stands of *Molinia* on wet ground in partial shade but not in dry areas away from the woodland. Despite the widespread occurrence of *Molinia*, *O. lineatopunctata* can be very locally distributed within apparently suitable areas. Falk (1991) lists it as nationally scarce although it probably does not warrant this status. The dates of capture range from late June to November with the majority in mid July to early August, though the fly was frequent in October in Welsh wetlands.

Opomyza petrei Mesnil, 1934. This species is probably overlooked because of its resemblance to the ubiquitous *germinationis*. In the field, its brighter colour helps to distinguish it from that species but some specimens are dark and have only a very vaguely differentiated central abdominal stripe so the other key characters need to be checked.

Opomyza petrei is a widespread species found in most parts of Britain, including Orkney, though Soós (1984) does not mention its presence here. No habitat preferences are apparent in the records. The larvae have been found in tillers of *Holcus lanatus* L., *Anthoxanthum odoratum* L. and *Agrostis tenuis* Sibth., and would seem to show a markedly different host plant preference to that of *O. germinationis* (Mesnil, 1934, Nye, 1958, 1959).

Opomyza punctata Haliday, 1833. Several authors have commented on the unsatisfactory separation of this species from *florum* (Collin, 1945; Hackman, 1958; Greve, 1981). It differs from *florum* in having 1–6 spots on the last section of vein R_{4+5} and, in my sample of eight females and six males, having significantly ($P<0.05$) smaller mean wing and thorax lengths with almost no overlap in size (Table 1). I have dissected and compared the male genitalia of both species but could find no differences in any external or internal components. The internal structures of *lineatopunctata*, *germinationis* and *petrei* are, by contrast, markedly different from this pair of species. The two species are provisionally kept separate in this work.

Opomyza punctata has been recorded from Kent (Parmenter, 1960; Allen, 1965), Essex, Suffolk, Norfolk, Lincolnshire, Hereford, Leicestershire, South and North Yorkshire, Durham, Cumbria, Northumberland and County Down, Ireland (type specimen). The only reference to the biology of the species is given by Allen (1965) who recorded it in areas dominated by *Dactylis glomerata* L. in his garden. It has twice been caught in *Arrhenatherum*-dominated sward on coastal dunes. The dates of capture range from July to early September so it is likely to be univoltine. It is classified as nationally scarce (Falk, 1991).

Opomyza punctella Fallén, 1820. This is a small, entirely yellow species. The extra crossveins and spots separate it from other British species except *lineatopunctata*

Table 1. Lengths of the wing, thorax (measured from its front end to the tip of the postnotum), and total body (mm). The wing and thorax were measured to the nearest 0.05 mm and the range quoted to the nearest 0.1 mm, and the total length to the nearest 0.25 mm. The dimensions were measured on at least ten specimens of each sex of the frequently occurring species

	Wing		Thorax		Total body	
	Female	Male	Female	Male	Female	Male
O. florum	4.4–5.1	3.8–4.4	1.9–2.1	1.5–1.9	4.5–5.75	3.75–4.5
O. germinationis	3.6–4.1	3.5–3.8	1.6–1.9	1.6–1.8	4.25–5.0	3.75–4.75
O. lineatopunctata	2.8–3.8	2.7–3.5	1.2–1.5	1.0–1.4	3.25–4.25	2.75–3.75
O. petrei	3.9–4.3	3.8–4.3	1.8–2.0	1.7–1.8	4.25–5.0	4.0–4.75
O. punctata	3.4–4.3	3.2–3.9	1.5–1.8	1.3–1.6	3.75–5.0	3.25–4.0
O. punctella	3.0	2.9	1.3	1.2	3.3	3.15
G. angustipennis	2.8	2.8	1.0	1.15	—	2.9
G. apicalis	2.1–2.4	1.9–2.7	0.9–1.5	0.9–1.1	2.75	2.3
G. balachowskyi	—	2.6–3.1	—	1.1–1.5	—	3.0–3.75
G. breviseta	2.3–2.7	2.4–2.6	1.1–1.4	0.9–1.2	2.75–3.25	2.5–3.0
G. hackmani	—	2.8–3.2	—	1.3–1.5	—	3.25–3.75
G. hendeli ?	2.4	—	1.1–1.2	—	3.0	—
G. majuscula	3.0–3.8	3.5	1.7–1.9	1.8	4.25	4.25
G. subnigra	2.3–2.7	2.2–2.7	1.1–1.4	0.9–1.3	2.75–3.75	2.5–3.25
G. tripunctata	2.6–3.4	2.7–3.4	1.1–1.5	1.0–1.4	3.25–3.75	2.5–3.75
G. venusta	3.3–3.7	3.2–3.6	1.4–1.8	1.4–1.7	3.25–4.0	3.5–4.0

which very occasionally also has extra veins and spots before the r-m crossvein but is distinguished by having a dorsal thoracic stripe.

Opomyza punctella would appear to be a species of cooler climates. Most records come from northern European countries. Although it is probably rare throughout most of its range, Hackman (1958) listed many localities for it in Finland and implied that it was frequent there. In central Europe, it is confined to mountainous areas and all Martinek's (1978a) Czechoslovakian records came from localities over 1000 m. The British distribution fits a similar pattern, with all records coming from Scotland (Grampian, Strathclyde) and northern England (South Yorkshire, Durham, Northumberland), though one is from coastal dunes. Its host plant is not known. Apart from one record in early September, all dates of capture are in July. The species is classified as vulnerable in Shirt (1987) and down-rated to rare by Falk (1991).

Geomyza angustipennis Zett., 1847. Both crossveins and the adjacent membrane are completely pale, making this small species distinctive. The first two tergites and bases of the others are orange. Gibbs (1989) gives a full description of the female. I have seen only two specimens and one of these is from Yugoslavia so the range of variation is not known. The drawing of the male genitalia (Fig. 3a) is of the Yugoslavian specimen in the Natural History Museum, London. Two other European species, *G. adusta* Loew and *G. denigrata* Czerny, may key out at the same couplet as *angustipennis* but both have dark thoraxes and only vaguely darkened wing tips so look superficially more like *G. breviseta* or *G. subnigra*.

The only known records are from the edge of a cornfield at Soakham, Kent (Andrewes, 1964), Lady Park Wood (deciduous), Gwent (Gibbs, 1989), and an unconfirmed record from Speybridge, Highland (Gibbs, 1989). It is classified as endangered in Shirt (1987) and downgraded to rare by Falk (1991).

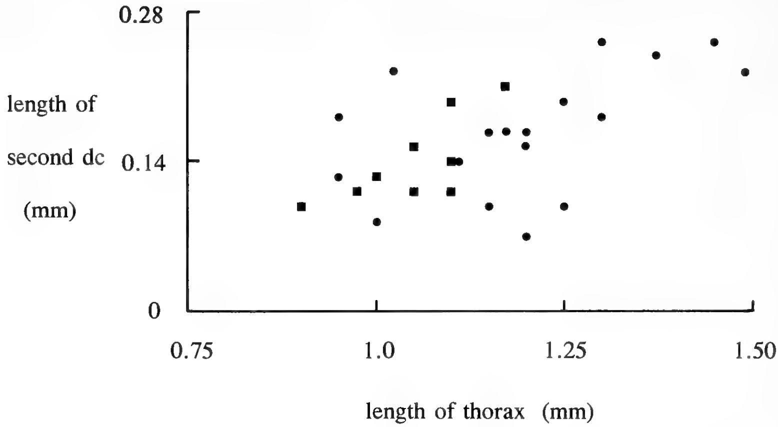

Fig. 6. Length of second dorsocentral seta (first postsutural) against thorax length for *Geomyza apicalis*. Circles = females; squares = males.

Geomyza apicalis (Meigen, 1830). The large apical wing spot, narrow wings and clear r-m crossvein make this species moderately easy to identify but the variable size, or even absence, of the first postsutural dorsocentral seta could lead this species to key out as *hendeli* in the keys of Collin and Czerny. However, there are good grounds for thinking that *hendeli* is merely a small form of *apicalis*. Measurements of the first three dorsocentral setae of 27 specimens of two series of *apicalis*, from Egham, Surrey, in the Natural History Museum, and from Blakeney, Norfolk, in the Castle Museum, Norwich, and single specimens from three other localities, show that the second (first postsutural) seta is shorter in smaller specimens (Fig. 6), although there is still considerable variation in its length. As a proportion of the length of the third (second postsutural) seta, the second seta varies from 24 to 80%, compared to the nearby acrostichal setae whose lengths are 17–30% of that of the third dorsocentral. The second dorsocentral of the smallest male in the Egham series could have easily been overlooked, being only one-third as long again as the acrostichals. Further comments are made under *hendeli*. The wing breadth as a percentage of its length is 20.5% (range 17.1–22.8%) for both female and male.

Two more European species would key out at couplet 15 in the key. *Geomyza pilosula* Czerny looks more like *G. balachowskyi* and has only pilose aristae. *Geomyza virgata* Czerny has only three dorsocentral setae but otherwise would appear to be very similar although Czerny described the male genitalia as smaller than usual. A male from Germany labelled *virgata* in the Natural History Museum looks like *G. apicalis* and its genitalia are of the *apicalis* type.

Geomyza apicalis has been recorded from Kent (Allen, 1982), London (Natural History Museum, as *hendeli*), Hertfordshire (Natural History Museum, in Collin (1945) as *hendeli*), Surrey, Essex (Collin, 1945), Cambridgeshire, Norfolk, Humberside, Derbyshire (Kidd, 1954), South, West and North Yorkshire (Skidmore *et al.*, 1985; Vockeroth, 1961) and Northumberland. The habitats where *G. apicalis* has been found include grazing marsh, a moist shaded clay slope with *Equisetum* and sparse grass, mud under reeds by an estuary, dunes and a sewage farm. Martinek (1978a, quoting

Karl, 1930) described it as a xerophile found on coastal dunes and in dry pasture, and Vockeroth (1961) stated that it occurs on dry ground. Not all the English localities conform with this preference for dry habitats. It is classified as nationally scarce (Falk, 1991).

Geomyza balachowskyi Mesnil, 1934. There are several species in the *combinata* group but only this species and *hackmani* have been recognized in Britain. These two can be separated reliably only on the basis of the male genitalia which need to be exserted so that the surstylar lobes are clearly visible. It is easy to mistake an incompletely visible twisted lobe of *balachowskyi* for that of *hackmani*. There seem to be no differences between the ovipositors of females caught in the same areas as males of the two species. The colour of the postnotum is the same as, or only slightly darker than, the rest of the thoracic dorsum. The wing width is 24–28% of its length. Two males and a presumed female from St Kilda, Shetlands, have exceptionally small and narrow wings, with the ratio of their width to length of 20–22%. The female wing length is only 2.58 mm, which is smaller than any male measured.

Geomyza annae Martinek and *martineki* Drake (which is the *combinata* of Martinek (1978b) and Soós (1984)) are known from central Europe (Drake, 1992). These two species differ from *balachowskyi* and *hackmani* in having slightly broader wings and no shading at the end of vein M, but principally in their genitalia (Martinek, 1978b). The *combinata* of Mesnil (1934) has similar genitalia and wings to those of *hackmani* but has a long anepimeral seta like that of *tripunctata*; no-one seems to have confirmed that such a fly exists.

This species is widespread and moderately frequent in Britain and records extend northwards to the Highlands. No habitat preferences are discernible in the records.

Assuming that Nye (1958, 1959) was dealing with *balachowskyi*, he reared it from *Lolium perenne* L., *Arrhenatherum elatius* (L.) Beauv. ex J. & C. Presl, *Holcus* species, wheat and barley. He cast doubt on the records of *G. combinata* larvae given by Frew (1923) and suggested that they were probably *G. tripunctata*. Nye found that the larvae overwinter in basal tillers, pupariate in April and emerge in May; they probably have a second generation in July. However, dates of capture of adults (not separated from *G. hackmani*) range evenly from the end of June to mid October.

Geomyza breviseta Czerny, 1928. This and *G. subnigra* are the two British species that always have dark thoraxes. Many specimens of *G. tripunctata* are dark but their wing pattern makes them amply distinct. *Geomyza breviseta* closely resembles *G. subnigra* but may be differentiated by its more chestnut-coloured thorax which also has more pronounced metallic reflections on its paler parts, and in having less contrast between the dusting on the thorax and abdomen. The apparently slight difference in the shading of the costal cell beyond vein h does seem to be distinct. However, all these characters are somewhat comparative and should not be relied upon to identify isolated females unless the ovipositor is closely examined by slide-mounting or viewing in alcohol; sternite 8 is apically emarginate in *breviseta* (Fig. 5f) but produced to a narrow, faint point in *subnigra* (Fig. 5e). Males are easily distinguished by the genitalia even if these are not exserted because the cerci are very small in *breviseta* but in *subnigra* are similarly proportioned to those of *tripunctata*. The dimensions of the wings and thorax are virtually the same in both species; the differences in Fig. 1 are due to the specimens that were drawn being different sexes.

Three other European species have dark thoraxes, so superficially resemble *breviseta* (and *subnigra*). *Geomyza paganettii* Strobl and *G. denigrata* Czerny have broad wings whose widths are about 34% of their lengths, and *paganettii* has four dorsocentral

setae. *Geomyza denigrata* and *G. adusta* Loew have only vaguely darkened wing tips and neither crossvein darkened.

Genuine specimens of *breviseta* seen by me come from Kent (Folkestone), Wiltshire (Coombe Bissett), Cambridgeshire (Barnack Hills and Holes NNR) and South Yorkshire (Pieces Bank). The species has been pooted from tussocks of *Poa trivialis* L. on limestone grassland which was lightly grazed by sheep, swept from moderately tall, slightly calcareous grassland and caught in pitfall traps set in ungrazed chalk grassland. Based on this evidence, it may be restricted to calcareous grassland.

Geomyza hackmani Nartshuk, 1984. Vockeroth (1961) and Chandler (1991) have pointed out that there is a second species of "*combinata*" here besides *balachowskyi* though Nartshuk's name and description of the second type appear to have been overlooked. Separation from *balachowskyi* can be made reliably only on the basis of the male genitalia. The ground colour of the postnotum in the eleven males seen by me is conspicuously darker than the rest of the thoracic dorsum although it is quite heavily grey-dusted. Until a much larger sample is checked, it would not be wise to use this character by itself or to assume that females may be identified using it. Because of the confusion, *hackmani* has probably been overlooked but it seems to be genuinely uncommon. It has been found in grasslands on alluvium, limestone, neutral clay and on freshwater and slightly brackish coastal grazing marshes. There are records from Surrey, Oxfordshire (Vockeroth, 1961), Greater London, Cambridgeshire, Worcestershire, Gwent, Cumbria and Aberdeenshire. Dates of capture range from early July to early September.

Geomyza hendeli Czerny, 1928. Czerny described this species from one female with its legs missing. Hackman (1958) concluded that it was just a small form of *apicalis*, because the wing pattern and shape were the same in both species and *apicalis* sometimes lacks the small postsutural dorsocentral seta and so resembles *hendeli*. Martinek (1978a) considered *hendeli* to be a good species, but a male and two females that Dr Martinek lent to me look very much like *apicalis*. These have very small postsutural dorsocentral setae although they are still discernible. *Geomyza hendeli* was added to the British list on the basis of a male (in the Natural History Museum) identified by Collin (1945). Its genitalia are identical to those of *apicalis*, its thorax is 0.98 mm long, its wing is 2.13 mm long and the wing's breadth is 20% of the length; these dimensions are well within the range of variation of *apicalis* (Table 1). I consider this specimen to be a not particularly small specimen of *apicalis*. Two other specimens labelled *hendeli* in the Natural History Museum are typical *apicalis*, one having a small postsutural dorsocentral seta on one side and genitalia that are indistinguishable from those of *apicalis*. Two females, from Wicken Fen, Cambridgeshire (I. Perry) and Dungeness, Kent (R. K. Morris), completely lack a small postsutural dorsocentral seta. They closely resemble *apicalis*, but features which may be trivial, that are found only in extreme examples of *apicalis*, are the dark brown occiput which is usually paler or patchy brown in *apicalis*, clearly defined dark notopleurae which are often only indistinctly brown in *apicalis*, and, on the dorsum of tergites 2–4, conspicuous marginal setae which are often not clearly larger than other setae in *apicalis*. I have not seen another specimen ascribed to *hendeli* from Holme, Norfolk (1983) collected from dunes which are frequently the habitat of *apicalis*. Thus, although the identity of *hendeli* is far from satisfactory, it would be prudent to retain the name for specimens that completely lack a small postsutural dorsocentral seta until a series of males can be compared with *apicalis*.

Geomyza majuscula (Loew, 1864). This species looks like a large *tripunctata* and for the small sample of *majuscula* that were measured, its wing and body dimensions fall just beyond the range of values for *tripunctata*. Apart from its larger size, *majuscula* may be tentatively separated from *tripunctata* in the field by the absence of the basal wing spot which is usually very distinct in live *tripunctata*. The thorax is usually orange. *Geomyza breviforceps* Hackman appears to be identical to *majuscula* and is most probably a junior synonym, as Hackman (1958) himself suggested.

Geomyza majuscula has been recorded from Hampshire (Chandler, 1991), Suffolk, Norfolk, Cambridgeshire, Dyfed, Cumbria and the Highlands. Most of the localities are rich fens or pond or river margins (one with *Carex*, another with *Phalaris arundinacea* L.). Capture dates range from March to October. It is classified as nationally scarce (Falk, 1991).

Geomyza subnigra Drake 1992. This is a moderately uncommon species in Britain and has been confused with the scarcer *breviseta* although some records of *breviseta* may genuinely refer to this species. It runs to either *breviseta* or *hendeli* in the keys of Collin and Czerny, depending on how well differentiated the longest subvibrissal bristle is. Its separation from *breviseta* is discussed under that species.

The known habitats are predominantly dry, e.g. chalk grassland and scrub, coastal dunes, coastal shingle, and suburban grassland. Wetter habitats included a Scottish birch wood. Audcent (1950) recorded it from *Bromus* sp. but it is more often associated with *Arrhenatherum elatius*. It has a life history unusual for the genus, adults occurring throughout the year; Ismay (1974) recorded it (as *breviseta*) at the roots of tussocks of *A. elatius* throughout a complete year though it was most abundant in autumn and winter, and a pair *in cop.* (in the Natural History Museum) was caught in mid February. Where the collecting method was known, it was usually tussocking or pitfalling but rarely sweeping. It has been observed running and jumping among the deeper layers of tall dune grassland. Although Falk (1991) considered it to be nationally scarce, its secretive behaviour is almost certainly the reason for the few records and is likely to prove widespread.

As there are many more verified records (*) of *subnigra* than of *breviseta*, the former is assumed to be the more frequent of the pair. Therefore, all unchecked records of "*breviseta*" are included here, though doubtless some have been correctly named by chance: Kent, East Sussex*, Greater London, Surrey*, Hampshire*, Avon, Wiltshire*, Dorset, Oxfordshire, Essex, Suffolk, Norfolk*, Cambridgeshire*, Worcestershire*, Dyfed*, Gwynedd, South Yorkshire, Northumberland* and Highland* (Allen, 1967, 1977; Parmenter, 1960; Collin, 1945; Ismay, 1974).

Geomyza tripunctata Fallén, 1823. The only other species of *Geomyza* with the bold wing pattern of *tripunctata* is *majuscula*, which lacks the long anepimeral seta and basal wing spot. The colour of the thorax is variable and, although usually blackish, it may be clear orange as it is in most specimens of *majuscula*.

Mesnil's *combinata* also possesses a long anepimeral seta, but the identity of this species is uncertain because the description of the wing in Mesnil (1934) does not tally with the figure that looks remarkably like *tripunctata* in Balachowsky & Mesnil (1935).

Geomyza tripunctata is the commonest species of the genus, widespread throughout Britain and found in almost all grassy habitats. It may be found from March to November, with a distinct peak in abundance in April and a less clearly defined one in later summer. Thomas (1938) concluded that it had two generations each year. Larvae have been recorded feeding on a number of common grasses but most often

on *Lolium* species (Thomas, 1938; Nye, 1959). After feeding in the central shoot of the grass stem, the larvae pupariate within it, overwintering mainly in the third (final) instar. This is a pest species of ley, and the numbers of larvae may be markedly higher in well fertilized leys than in those receiving low inputs of nutrients (Moore & Clements, 1984). The larvae are parasitized by the braconids *Chasmodon apterus* Nees and *Phaenocarpa livida* Haliday and the pteromalid *Stenomalinus* sp (Thomas, 1938; Moore *et al.*, 1986).

Geomyza venusta (Meigen, 1830). This species superficially resembles *balachowskyi* and *hackmani* in body colour and wing size but differs from them in crossvein r-m being entirely pale, the wings being markedly broader (the width 27–33% of the length), the thorax noticeably shiny and with brown marks outside of the postsutural dorsocentral setae and a reddish or brownish tinge on the notopleura, and the postnotum often being black, at least centrally. The male genitalia are distinctive but the European species *G. annae* Martinek has similarly bilobed apices to the surstylar lobes (Martinek, 1978b). That species has a small spot on the r-m crossvein like *balachowskyi*.

Although *G. venusta* has been infrequently recorded in Britain and Falk (1991) classified it as nationally scarce, on the Continent it is a fairly common and widespread though minor pest (Balachowsky & Mesnil, 1935, Soós, 1984). Its larvae have been recorded from *Bromus* and they overwinter within the shoots (Balachowsky & Mesnil, 1935). Most of its British localities are chalk grasslands and it can be frequent in this habitat (L. Clemons, pers. comm.; Allen, 1982). There are records from Kent, East Sussex, Surrey, Hampshire, Hertfordshire, Buckinghamshire, Oxfordshire, Cambridgeshire, Salop, Strathclyde and Grampian. Its flight period is from early June to late August, with most records in July.

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BOOK REVIEW AND NOTICES

Principles of acarology by G. O. Evans, CAB International, Wallingford, xviii + 564 pages, £65, hardback.—The ticks and mites are almost as diverse as insects in their habits and lifestyles, being terrestrial, aquatic (salt and fresh water), herbivores (including gall-makers), predators, commensals and parasites. This astonishing variety is excellently presented in this formidable textbook. The book concentrates on the functional morphology of the Acari, constantly comparing and contrasting structure and function across the many different modes of life. The largest chapter is on classification, detailing the many different groups of ticks and also the relationship between the ticks and other arthropods. Mites and ticks are an order of magnitude smaller than insects—for example the holothyrids which are regarded as 'large to very large' have adults ranging from 2 to 7 mm! Nevertheless, many species are of major economic or medical importance—*Varroa* on honeybees, Lyme disease transmitted by ticks, spider mites on garden plants and crops, chiggers etc—and many have developed intimate relations with insects and other animals. All aspects of the creatures' biology are considered, profusely illustrated and thoroughly referenced.

R. A. Jones

Insect pollination of crops, 2nd edn by John B. Free, London, Academic Press, 1993, xii + 684 pages, hardback.—After a general introduction to pollinating insects—mainly honeybees, bumblebees and solitary bees—there follows an extensive review of pollination, arranged by plant crop family.

The larvae of gall midges (Diptera: Cecidomyiidae) by B. M. Mamaev and N. P. Kirvosheina, translated by J. H. Wieffering, edited by J. C. Roskam, Rotterdam, Balkema, 1993, x + 294 pages, £30, hardback.—This is a translation of the original Russian work *Lichinki gallits*, published in Moscow in 1965. After introductory chapters on biology, comparative morphology, collecting, preservation and study, the major portion of the book is devoted to a systematic outline of gall midge larvae.

BENHS INDOOR MEETINGS

22 February 1993

The President, Dr J. MUGGLETON, announced the deaths of Mr N. A. Richardson, who was a special life member, and Mr L. Hugh Newman, who had been a member for a number of years before and after the war.

Mr G. BURTON said he would accept membership subscriptions if there were any late-payers present.

Mr R. MORRIS said that if any members were still undecided about attending the Cumbria weekend field meeting, they should book a place as soon as possible, since in a couple of weeks time he would have to cancel the excess places that he had booked at the field centre. He said he was also hoping to organize a visit to the French Pyrenees in 1994 and asked anyone who was interested to contact him.

The ordinary meeting was then followed by the Annual General Meeting.

Minutes of the Annual General Meeting of the Society held at the rooms of the Royal Entomological Society of London at 6.30 p.m. Chairman: The President, Dr J. Muggleton. Present: 28 members.

Minutes of the last Annual General Meeting were read and signed.

The Secretary read the Council's report, followed by the Treasurer who read his report. The Treasurer then invited questions on his report, but there was none. The Editor, Librarian and Curator then read their reports and Mr A. J. Pickles read the report of the Hering Memorial Fund. The President proposed the adoption of the reports, this was seconded by Mr D. Young and passed unopposed.

The President then read the names of the Officers and Members of Council recommended by the Council for 1993–94 and, as no other names had been submitted, he declared the following duly elected. President: Dr D. Lonsdale; Vice-Presidents: Dr J. Muggleton, Dr P. Waring; Treasurer: A. J. Pickles; Secretary: R. F. McCormick; Editor: R. A. Jones; Curator: P. J. Chandler; Librarian: S. R. Miles; Lanternist: M. J. Simmons; Ordinary Members of the Council: B. R. Baker, J. R. Dobson, R. Dyke, A. J. Halstead, M. Parsons, C. Penney, S. C. Pittis, C. W. Plant and M. J. Sterling.

The Secretary then read Bye-law 22 (d) and invited motions or questions. There were none.

The President then read his report and gave his address.

The President then installed the new President, Dr D. Lonsdale.

The President proposed a vote of thanks to the retiring President, and this was seconded by Mr R. Morris. The President asked for permission to publish the Presidential address, and this was given.

Mr A Stubbs gave a vote of thanks to the retiring Officers and Council.

Auditors: The President proposed the election of Mr R. A. Bell and Col. D. H. Sterling as Auditors for the coming year with Council being empowered to appoint registered Auditors under the Charities Act. This was seconded by Mrs F. Murphy and Mrs. A. Burton and passed unopposed.

9 March 1993

Mr A. J. HALSTEAD showed, as evidence of spring having arrived after the previous week's cold spell, live specimens of two overwintered insects found at the RHS Garden, Wisley, Surrey. These were the plant bug *Heterogaster urticae* (F.) (Hemiptera:

Lygaeidae), which is associated with stinging nettles, and the picture-winged fly *Tephritis vespertina* (Loew) (Diptera: Tephritidae), which develops as larvae in the flower heads of the wildflower cat's ears (*Hypochaeris radicata* L.).

Mr R. D. HAWKINS showed a specimen of the click beetle *Athous campyloides* Newman (Coleoptera: Elateridae) taken at dusk on 27.vi.92 from a whitewashed wall in a small suburban garden bordering on farmland at Horley, Surrey (TQ 291 419). This appears to be the first record for the vice-county of Surrey. Mr H. Mendel states that this species has a south-easterly distribution in Britain and is nocturnal; it is usually found by sweeping at night.

Mr R. A JONES showed some colour transparencies taken on a visit to Florida, USA in January 1993. They showed ants and several larvae of a *Microdon* sp. (Diptera: Syrphidae). The three British *Microdon* spp. all have larvae that develop in ants' nests.

The names of Mark Iley, David Brian Wooldridge, Alexander Josef Kolaj, Thomas D. Harrison, Martin Charles Townsend, Robert William Bogue, Christopher John Mulvey and Ian Frank Smith were read for the second time and they were duly elected as members.

Dr R. KEY said that there were still five places available for the Cumbria field meeting weekend.

Mr R. UFFEN said that on a recent visit to the Savill Garden, Surrey (near Windsor Great Park) he had seen leaf mining activity on outdoor azaleas by larvae of the moth *Caloptilia azaleella* (Brants) (Lepidoptera: Gracillariidae). He had known this insect as a pest of greenhouse azaleas and wondered if it regularly occurred out of doors. Mr Halstead said that it was taken in the Rothamsted light trap at Wisley Garden and so was presumably living successfully in the open. Mr Uffen had also noted the burrowing activities at Savill Garden of the dung beetle *Typhaeus typhoeus* (L.) (Coleoptera: Geotrupidae). He knew of only about three localities for this beetle in Hertfordshire. Mr Halstead said it occurred at Wisley Garden and Mr Softly said it was present at Hampstead Heath. Dr R. Key said it occurred in sandy soil in southern England and on heather moorland in northern areas.

Mr A. FOSTER spoke on the NCC's East Anglian Fens Survey on which he worked during 1988–90. A large number of fens in Suffolk, Norfolk and Cambridgeshire were surveyed, together with other wetland habitats in the area, such as pingo pools and valley mire bogs. Pitfall traps were used to record the ground fauna, with water traps at ground level and raised on posts for recording flying insects. A wide range of invertebrates, particularly beetles, flies, plant bugs, hymenoptera and spiders, were subsequently identified by NCC staff and other helpers. The survey recorded 133 Red Data Book species, some of which are confined to the East Anglian fens. There were a number of species recorded as new to Britain, including a fly and a chalcid wasp new to science. Environmental variables, such as plant communities, height of vegetation, the degree of burning/flooding/salinity and cutting, were noted to try and detect any affinities between certain insects and the habitat/management types.

Fens need regular management in the form of cutting to prevent them developing into willow/alder carr. Fen hay meadows are now a scarce habitat and are cut annually in the summer. They contain many flowering plants and are rich in insects. Where cut hay is not removed from the site but left in heaps, the decomposing vegetation supports litter insects and creates nesting sites for grass snakes. Sedge (*Cladium mariscus* (L.) Pohl) is used for thatching the ridges of roofs and is cut in late June–August on a 3 to 4-year cycle. This species of sedge has few insects dependent on it but sedge beds nevertheless have considerable entomological interest due to other

plants growing amongst the sedge. Reed (*Phragmites australis*) (Cav.) Trin. is cut during the winter. Cut reed beds are open in the spring but by midsummer the reeds can be six feet tall and few other plants grow amongst them. Reed beds do however support a wide range of insects, including 23 RDB species and 71 classed as nationally scarce. Some of these insects are more frequent in unmanaged reed beds where the lack of cutting has allowed a build up of litter and old stems.

13 April 1993

Mr R. UFFEN showed live specimens of a male and female solitary bee *Anthophora plumipes* (Pallas) (Anthophoridae). The male was taken at *Lamium album* L. (white dead nettle) flowers and the female at its nest site in an old clunch wall at Ashwell, Herts. The females were buzzing in dozens about two sections of the wall but only on the eastern side. Also present at the nest site and shown as a live specimen was the much more local bee *Melecta albifrons* (Forster) (Anthophoridae), which is a cleptoparasite of *A. plumipes*.

Mr A. J. HALSTEAD said that *Anthophora plumipes* could be found nesting in the mortar on the south face of an old wall in Royston, Herts. Mr C. W. PLANT said that it also nested in a wall in the East Ham district of London.

Dr D. LONSDALE showed some live 2-spot ladybirds, *Adalia bipunctata* (L.), collected on 21.iii.93 from their overwintering site behind shutters on a house at Chawton, Hants. Of the 97 specimens collected, 75 were of the typical form and there was one weak *annulata* form. The others were melanic forms with six *quadrimaculata* and nine *sexpustulata*. The plant bug *Heterogaster urticae* (F.) (Lygaeidae) was also found overwintering with the ladybirds.

The President announced that, as required by the Society's constitution, he was notifying the meeting that Council intends to introduce a single subscription rate of £12.50 in 1994, when there will no longer be a distinction between country and London members. This proposal will be put to the membership for approval at a special meeting to be held on the occasion of the September ordinary meeting.

Dr J. MUGGLETON said that the official opening of the Pelham-Clinton building at Dinton Pastures would be held on Sunday, 27 June. Sir Richard Southwood will perform the ceremony. Refreshments will be served but as the function room at the country park has a capacity of about 70 persons it may be necessary to hold a ballot for places. Further details will be circulated to members shortly. The building is open to members between 10.30 a.m. and 4.00 p.m. on the second and fourth Sundays in the month.

Mr B. BAKER had noted several insects earlier in the day as he had walked through Kensington Gardens. He had seen a flowering cherry with frass on the bark, presumably produced by larvae of the tortricid moth *Enarmonia formosana* (Scop.), and on the trunk of a lime tree he had seen cocoons of the moth *Bucculatrix thoracella* (Thunb.) (Lyonetiidae). He had also seen an adult *Esperia sulphurella* (F.) (Oecophoridae) which he thought was early for this species.

Mr R. SOFTLY said he had recently spent some time in Morocco on the south side of the high Atlas mountains. He had run a Heath trap for 10 nights between 28.iii and 6.iv in an area of stony desert. He had attracted about 200 moths of about half a dozen species per night, one of which was the striped hawk moth, *Hyles lineata* (F.). There were no food plants in the area but on the 10 successive nights he had caught 1, 0, 9, 4, 8, 5, 3, 1, 1 and 0 specimens. He thought this variation in numbers might indicate a migration of this moth through the area.

Mr I. WOIWOD said that this year Rothamsted Experimental Station would be celebrating its 150th anniversary and would be holding open days on 4–6 June. Members of the Society would be most welcome to see the work of the station, including that of the insect survey team.

Mr I. WOIWOD then spoke on a new look at moths on farmland. He outlined the history of the Rothamsted Insect Survey which has its origins in a moth trap run on a nightly basis at Barnfield in the experimental station by C. B. Williams during the 1930s and 40s. Trapping began again during the 1950s and by the mid-1960s a national network of traps had been developed, many of which are run by volunteers. One of the principal aims of the scheme is to build up long data runs to indicate how moth populations vary from year to year. Statistical analysis of the numbers of moths caught enables an index of diversity, called alpha, to be calculated, which relates moth diversity to the quality of the habitat around the trap site. Mr Woiwod described several trap sites within the Rothamsted estate which have been run since the 1960s, including one at the original Barnfield site. The alpha number for this site had declined since Williams's period of trapping, due to changes in land use, such as the removal of hedges and increased use of herbicides. A woodland site, Geescroft, showed comparatively little variation in its alpha number from year to year, while the Allotment site showed marked differences as the surrounding land had gone from cultivated allotments to arable field to weed patch and back to arable with buildings.

Since 1990 a network of 26 Rothamsted traps has been run within the grounds of the experimental station, including the four previously existing trap sites. The aim of this project is to map the spatial distribution of moths across the various habitats present at Rothamsted. Mr Woiwod hopes to run these traps for at least 6 years in order to confirm the trends shown during the initial 3-year period. He showed a series of slides of computer-generated distribution maps showing how some species seem to be associated with certain habitat types. Some of the more abundant species have been investigated to determine the degree of genetic variability within a species caught at the various trap sites. This is done by the identification of certain enzyme systems using electrophoresis equipment. Some species do show significant differences between trap sites, indicating that these moths do not move far and tend to breed in relatively isolated communities; other species fly freely and show little genetic variation as a result. The identification of enzyme systems by electrophoresis can also be used to separate difficult species of moths such as *Epirrita* spp.

The diversity of moths at the 26 traps varies, with the highest alpha numbers being recorded in the wooded areas and the lowest in the intensively cultivated sites. At Rothamsted it has been found that the habitat within a 50-metre radius of a trap accounts for 58% of the variation in the alpha number. It is hoped that the results of this survey can be used to predict changes in the moth fauna when changes in land use occur, such as land being taken out of cultivation for set-aside or farm woodland.

To date 462 species of macrolepidoptera have been recorded at Rothamsted, with new species still being taken. Mr Woiwod closed his talk with slides of some of the more interesting species taken at Rothamsted. These included *Amphipoea fucosa* (Frey.), *A. lucens* (Freyer), *Celaena leucostigma* (Hübn.), *Semiothisa signaria* (Hübn.) and *Eupithecia sinuosaria* Eversmann.

11 May 1993

The President, Dr D. LONSDALE, announced the death of Lt. Col. Gordon Eastwick-Field.

Mr R. A. JONES showed a specimen and photograph of the land sandhopper *Arcitalitrus* (*Talitrodes*) *dorrieni* (Amphipoda: Talitridae) found in a garden at Morvah, Cornwall, on 10.v.92. This species, which is the only truly soil-dwelling sandhopper in Britain, was first discovered in the Scilly Isles in 1925. It is thought to have originated from Australasia and is now widespread in southern England, reaching as far as Surrey; it also occurs in Argyll and County Galway. Mr Jones also showed a live specimen of a common carabid beetle, *Harpalus affinis* (Schrank) taken at Nunhead Cemetery, London SE15, on 11.v.93. This species was formerly called *H. aeneus* (F.), a name that refers to the beetle's usual metallic golden or brassy green coloration. This specimen, however, had a deep metallic purple sheen.

Mr A. J. HALSTEAD showed two live specimens of a worm leech, *Trocheta* sp., sent to him on 25.iv.93 from a garden at North Holmwood, Dorking, Surrey. They had been found in wet sticky soil near a pond. This type of leech breeds in water but moves into the nearby soil where it preys on earthworms. He also exhibited a live female privet hawk-moth, *Sphinx ligustri* L., bred from a caterpillar found feeding with others on a garden shrub *Spiraea* × *arguta* Zabel at Wood Dalling near Norwich, Norfolk, and shown at the 8.ix.92 indoor meeting. Various food plants have been recorded apart from privet and include lilac (*Syringa vulgaris* L.), ash (*Fraxinus excelsior* L.), *Viburnum tinus* L., *Phillyrea* and holly (*Ilex aquifolium* L.) but there do not appear to be any previous records of this caterpillar on *Spiraea*, which is in the Rosaceae family.

Mr D. HACKETT showed specimens of oak bark which had been tunnelled by larvae of the jewel beetle *Agrilus pannonicus* (Pill. & Mitt.) (Buprestidae). He also showed a preserved specimen of the larva and an adult beetle that had died in its characteristic D-shaped exit hole. The specimens came from dead standing trees in Queens Wood, Highgate Wood and Cherry Tree Wood in London N10.

Dr D. LONSDALE showed live specimens of some seasonally emergent dead wood beetles collected at Alice Holt Forest, Hants. These were *Thanasimus formicarius* (L.) (Cleridae), commonly known as the ant beetle, which mimics a wood ant and preys on bark beetles. It was found in the Laboratory at Alice Holt Research Station on 30.iv.93. *Rhagium bifasciatum* F. (Cerambycidae) and *Scaphidium quadrimaculatum* Ol. (Scaphidiidae) were found on a pile of pine logs on 11.v.93. *Rhagium bifasciatum* has been fairly abundant at Alice Holt only in the last 2 years and the exhibitor had not previously recorded the other two species there. It is probable that these beetles have benefited from the availability of wind-blown timber, especially unharvestable off-cuts left after clearance.

The names of Dr Jeremy Greenwood and Neil Christopher Pinchbeck were read for the second time and they were duly elected as members.

Dr I. MCLEAN said that despite short notice the first workshop at Dinton Pastures had been a success with nine members and guests attending a meeting on Diptera.

Dr J. MUGGLETON said the next open day at the Pelham-Clinton building would be Saturday, 30 May, and not the usual fourth Sunday. This was due to the visit of a party of French entomologists. A marquee is being provided by the Country Park for the building's official opening on 27 June and so there is no longer likely to be a restriction on numbers able to attend the luncheon.

Mr M. FURZE spoke on the use of macro-invertebrates for biological monitoring of water quality. Pollutants in water can be detected by chemical analysis but it is an expensive and resource-intensive procedure. Some chemicals degrade rapidly making them difficult to detect, especially if they have been discharged late on a Friday when the river authority staff have gone home for the weekend. As a consequence chemical analysis is only used to monitor certain specific chemicals in some waterways.

Biological monitoring is now the main method by which changes in water quality can be detected. Invertebrates have the advantages of being of widespread occurrence, diverse, relatively immobile, cheap to sample, mostly easy to identify to family level, and they show the effects of pollution over time. Different families of insects vary in their tolerance of pollution, especially to organic factors such as the depletion of oxygen. Various monitoring systems using invertebrates have been devised, such as the Saprobien system, Trent biotic index, Chandler score, Continental indices, and the Biological Monitoring Working Party (BMWP) system. It is the last mentioned that is now in use throughout Britain. Families of invertebrates are given a score of 1–10 according to their tolerance of pollution, with the most sensitive scoring 10 and the most tolerant 1. Rivers are sampled by using a net or dredge bucket for a standard time, and the invertebrate families are identified and scored. Adding up the scores gives a total value for the site and the average score per taxon (ASPT) is calculated by dividing the total score by the number of taxa. The ASPT is the more reliable figure, since some high-scoring families will not occur in some rivers however clean they are if other environmental factors are wrong. Total scores can also be increased by more frequent sampling whereas the ASPT figure is more constant. The speaker has been involved in a project called the River Invertebrate Prediction and Classification System (RIVPACS). This involved sampling a wide range of clean rivers and streams throughout Britain at a number of sites along their lengths. Details of the river, such as width, depth, rate of flow, river bed characteristics, altitude, distance from source, and chemical factors such as pH and salinity, were measured, as well as monitoring the invertebrates. Analysis of the results with a system called two way indicator species analysis (TWINSPAN) enables the invertebrate fauna to be related to certain types of river systems. Twenty-five river types have been identified and using the TWINSPAN system it is possible to predict which invertebrate families ought to present in a clean water sample of each of those river types. An environmental quality index (EQI) can be calculated by dividing the observed ASPT value by the predicted value. The closer this is to one, the better is the quality of the water. Statistical means can be used to give confidence limits to the EQI to take into account variations caused by chance in the sampling procedure. Water quality in rivers can be graded into good, fair, poor and bad bands according to the EQI value.

BOOK REVIEW

The spiders of Great Britain and Ireland by M. J. Roberts, compact edition, Harley Books, Colchester, 1993. Part 1 "text", 458 pages including 7 colour plates, £49.95, paperback. Part 2 "plates", 256 pages including 236 colour plates, £39.95, paperback. Parts 1 and 2 together £80.—At £80 for the two parts, this edition offers quite a saving on the £135 three-volume hardbound edition (1987). Described as a 'compact' edition, it is a two-volume paperback version of the hardback—Volumes 1 and 2 are bound together as Part 1, Volume 3 thus becomes Part 2. In every other way it is identical, word-for-word, page-for-page, to the superbly produced hardback, lavishly illustrated throughout with line figures and diagrams and retaining the 243 exquisite colour plates. Also included at the end of Part 1 is a 16-page appendix (available separately, £3.75). It lists corrections, alterations and additions, including numerous changes to the British check list. Six new species are described and illustrated and additional illustrations are shown for various species of *Philodromus*, a genus recently revised. A snip at £80, this definitive book is now well within the means of many more of us and a must for anyone with even the mildest of interests in spiders.

R. A. Jones

BENHS FIELD MEETING

Bernwood Forest, 31 July 1993

Leader: **Paul Waring.** This meeting was held jointly with members of Butterfly Conservation and the Buckinghamshire Invertebrate Group. The leader was joined by 19 members and friends during the day and by 42 people at night. The Forestry Commission had kindly provided keys so that we could get cars, generators and other overnight equipment into the woods rather than leaving them in the public car park. As Claude Rivers remarked as he sat in the cavalcade of 14 cars entering the wood for the day-time session, the general public had reason to be grateful because entomologists would otherwise have completely filled the car park! Twenty-four mercury vapour lights and at least one actinic were operated during the night-time session and we succeeded in dispersing traps throughout the whole of this 1000-acre site, including six lights in Waterperry Wood.

The main objectives of the meeting were to note insects generally during the day-time session, which started at 11.00 a.m., and then to record as many species of macro-moths as possible during the night-time session to provide 1990s records to up-date and possibly add to the historical list of 431 species recorded up to the late 1980s (Waring, 1988, 1990a). Copies of the full list for the Shabbington complex were issued for annotation and interest to those that required them. Before we started sampling, Dr Rachel Thomas gave a brief presentation on the management history of the wood—the subject of her PhD thesis (Thomas, 1987). This provided the context for interpreting the changes in the insect fauna (e.g. Peachey, 1980; Waring, 1990b) and also drew attention to special areas of recent management.

On a good night it is possible to record upwards of 100 species of macros at this time of year in woodland sites. Unfortunately the weather was far from ideal during both day and night sessions. By day it was at least dry but rather cool with only intermittent sunshine. The butterflies were sluggish. Sixteen species were seen of which the most notable was the white admiral *Ladoga camilla* (L.) of which two individuals were seen visiting flowers of creeping thistle *Cirsium arvense* (L.) Scop. and bramble *Rubus fruticosus* L. agg. near the Oakley Wood entrance. The other species, in generally small numbers, included the large, small and Essex skippers *Ochlodes venata* Br. & Grey, *Thymelicus sylvestris* (Poda) and *T. lineola* (Steph.), the latter comprising a fair proportion of the total, the large, small and green-veined whites *Pieris brassicae* (L.), *P. napi* (L.) and *P. rapae* (L.), the purple hairstreak *Quercusia quercus* (L.) and common blue *Polyommatus icarus* (Rott.), peacock *Inachis io* (L.) and red admiral *Vanessa atalanta* (L.), speckled wood *Pararge aegeria* (L.), marbled white *Melanargia galathea* (L.), gatekeeper *Pyronia tithonus* (L.), meadow brown *Maniola jurtina* (L.) and ringlet *Aphantopus hyperantus* (L). The numbers and distribution of marbled whites within this wood are rather variable but on this visit over a dozen were seen along the main east–west ride. The verges of several of the major rides looked rather better in terms of the abundance and variety of flowers than in some recent years.

The day-time group spent some time around the pond which the Forestry Commission created in the centre of the wood in the winter of 1986/1987. There is now a large stand of the greater reed-mace or bulrush, *Typha latifolia* L., by the pond and inspection of the stems revealed the workings of the bulrush wainscot *Nonagria typhae* (Thunb.). Dragonflies and damselflies seen included *Aeshna grandis* (L.), *A. cyanea* (Müller), *Sympetrum striolatum* (Charp.), *Enallagma cyathigerum* (Charp.), *Ishnura elegans* (van der Linden) and several *Lestes sponsa* (Hanse.). Some of the moths recorded by day included the yellow shell *Camptogramma bilineata* (L.), Six-spot burnet *Zygaena filipendulae* (L.) and larvae of the cinnabar moth

Tyria jacobaeae (L.). A small amount of beating was done and as a result several larvae of the poplar lutestring *Tethea or* (Denn. & Schiff.) from aspen *Populus tremula* L. and the larvae of the green silver-lines *Pseudoips fagana* (F.), vapourer moth *Orgyia antiqua* (L.) and engrailed *Ectropis bistortata* (Goeze) from silver birch *Betula pendula* Roth were seen. Just over 30 species of micro-moth were noted from leaf-mines and by other means, all of rather common species. Among insects of other orders were the eyed ladybird *Anatis ocellata* (L.), several of which were seen at rest on plants including marsh thistle *Cirsium palustre* (L.) Scop., and the cerambycid beetle *Strangalia maculata* (Poda) on flower-heads of angelica *Angelica sylvestris* L.

The cloud that had been with us for most of the afternoon cleared by dusk of course! As a result the temperature fell. It was barely 13°C at 10.00 p.m., 11°C at midnight and those of us that stayed in the wood all night, sleeping in cars, enjoyed a chilly 6°C. The low temperatures resulted in very small catches in the traps and the full moon by 11.00 p.m. did not help. What was doubly frustrating was that the following night was altogether warmer and cloudier and I had a larger catch in my garden trap than I did in the wood!

What was noticeable among so many lights in the wood was that those in the shelter and to at least some extent shaded by trees, such as those in the narrow main ride from the Hell Coppice gate, caught more moths than those out in the open on the widest ride intersections. This type of result is well-documented in Waring (1990a). Conversely on cloudy warm still nights in mid-summer, lights at ride intersects are likely to catch more species and often more individuals, particularly in the case of 125-W lights rather than actinics.

In spite of the small catches per trap, over 70 species of macro-moth were recorded, thanks to the large number of traps used. Furthermore two major discoveries were made, adding the hornet clearwing *Sesia apiformis* (Clerk) and pine hawk-moth *Hyloicus pinastri* (L.) to the all-time list for the site.

Two pine hawk-moths were recorded by George Higgs and party who operated an MV light over a sheet at intersection 18 in the centre of Waterperry Wood from dusk until midnight (SP608092). The moths arrived just before midnight. This is the first time the species has been recorded in Waterperry Wood and it has not been observed in the Hell Coppice/Shabbington woodlands either (Waring, 1988). The absence of previous records of this species is in spite of the intensive light-trapping during the 1980s and also much beating of conifers for moth larvae during the Ph.D. studies of Hatcher (1989). The records are very important locally. The moth has turned up periodically in the Oxford area over the years, at first as singletons, but now it is assumed to be breeding in the Wittenham and Boars Hill areas. There is a fair amount of Scots pine *Pinus sylvestris* L. and other *Pinus* species in Bernwood and it may be that the moth has at last established a breeding colony in these woodlands. The spruce carpet *Thera britannica* (Turner) and the dwarf pug *Eupithecia tantillaria* (Boisd.) were the only conifer-dependent macro-moths recorded from the site prior to 1950. The larch pug *Eupithecia lariciata* (Freyer), grey pine carpet *Thera obeliscata* (Hübn.), tawny-barred angle *Semiothisa liturata* (Clerck) and bordered white or pine looper *Bupalus piniaria* (L.) were added to the list in the 1960s but it was not until the 1980s that the barred red *Hylaea fasciaria* (L.), satin beauty *Deileptenia ribeata* (Clerck), pine beauty *Panolis flammea* (Denn. & Schiff.) and Blair's shoulderknot *Lithophane leautieri* (Boisd.) were recorded (Waring, 1988, 1990a). Had these species existed in the wood in their present numbers during the 1950s and 1960s they would undoubtedly have been recorded earlier.

The other new addition to the all-time species list for Bernwood Forest is the hornet clearwing. During the field meeting Martin Townsend was sugaring sheltered

Fig. 1. Cavalcade of entomologists entering Bernwood Forest, Buckinghamshire, for day-time part of field meeting. Photo P. Waring.

Fig. 2. Day-time sampling of vegetation on ride 36 in Yorks Wood, part of the Bernwood complex, showing birch and aspen regrowth. Larvae of the poplar lutestring *Tethea or* were beaten from the latter. Photo P. Waring.

Fig. 3. Gathering in the car park for night-work on the Bernwood Forest field meeting. Photo P. Waring.

Fig. 4. George Higgs (4th from left) and party at light at which two pine hawk-moths *Hyloicus pinastri* were recorded in Waterperry Wood, the first records of this species for the site in 80 years of recording. Photo P. Waring.

trees on the western edge of the Shabbington complex by the Bernwood Meadows when he noticed an empty pupal case protruding from the base of one of the poplars in the plantation (compt. 31, Yorks Wood, SP609109). The tree was about 3 m in from the edge of the wood and vegetation around the base was sparse. The trunk probably receives some direct sunshine. The moth was actually discovered in the wood the previous month and reported at this meeting by Peter and Di Sharpe. On 27.vi.1993 Peter had been turning back some bark on a Poplar at the eastern end of the adjacent compartment 32, on the north edge of the ride running east from Intersection 3 (SP614105), when a live pupa fell out. The adult moth was reared and emerged successfully on 29.vi. This adds to a cluster of recent records in the Oxford area (Waring, 1992).

Three other species attracted particular interest and comment from the night-workers and are worthy of mention. The buff footman *Eilema deplana* (Esp.) was about in good numbers throughout the woods, from Oakley Wood in the north to Waterperry Wood in the south, with several in many of the traps. Several recorders remarked that they had not seen this somewhat local moth before. The oak nycteoline *Nycteola reveyana* (Scop.) was another 'new' species for some. This species was recorded in the semi-natural mature coppice regrowth of compartment 12 in Oakley Wood, and in Yorks Wood between compartments 23 and 24 on the main ride from Hell Coppice. The latter individual was of a fine red and grey form that seems to predominate in these woods. Several satin beauties, including females, were captured in the traps along the above ride, which runs by stands of mature conifers and has plenty of the cover with which both this species and the oak nycteoline are often associated. In contrast larvae of the oak nycteoline that I have beaten in these woods have been on free-standing oaks, in sunny places but adjacent to cover. The satin beauty turned up at other traps throughout the woods during the meeting but in smaller numbers.

The opportunity was also taken by light operators to record numbers of melanics, banded and typical forms of several species for comparisons of frequency between different habitats.

The lesser common rustic *Mesapamea didyma* (Esp.) was confirmed from the Shabbington complex, where specimens were taken on the main ride just north of Hell Coppice (D. Brown, pers. comm.).

Several glow-worms *Lampyris noctiluca* (L.) were reported along the main rides in Oakley and Waterperry Woods.

Although the weather was against us the meeting did succeed in bringing together a large number of the societies' members and provided an opportunity to discuss our forays and discoveries so far this season. I would like to thank all those who attended and helped to make this meeting such a memorable occasion and to thank everyone for sending in their species lists so promptly. If any of you are still wondering what happened to my assistant, his five generators and the walkie-talkie radios that would have avoided Rachel and I travelling around the wood several times during the night, the answers are that the assistant did not have an accident on the road, nor was his van stolen as we feared; he phoned the day after to report that the loaded van was locked in a garage on the Friday night and he couldn't get hold of the key on the day of the meeting! The owners of the radios had not renewed the licences to use them!

Acknowledgements

I would like to thank English Nature and the Forestry Commission for permission to hold the field meeting.

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BOOK REVIEW

The butterflies of the Greek island of Ródos: taxonomy, faunistics, ecology and phenology, etc by Alain Olivier, Antwerp, Vlaanse Vereniging voor Entomologie, 1993, 250 pages, 2 colour plates, numerous black and white illustrations and tables, paperback, £33.—This excellent book brings together a great deal of the latest information not only on the butterflies of Ródos (Rhodes) but also for many of the species listed, useful references to the Balkans, Greece and Turkey. It will, therefore, be an invaluable aid to anyone interested in the natural history of the butterflies of this area.

The text includes full sections on the background to the biology of these insects with details of geography, geology, climate and especially vegetation as well as a useful history of butterfly collecting on Ródos from Zeller in 1847 to the present.

The systematic list of species summarizes and brings up to date knowledge of distribution records and ecology of all 47 butterflies known to occur on Ródos as well as listing erroneous or doubtful species records. For each species a critical assessment of the taxonomy is also given which for several species brings together details not readily available to the general collector and which for some species is very full and important, e.g. *Maniola telmessia* (Zeller 1847).

Although the book is not of course intended as an identification guide, the colour plates and drawings of genitalia are excellent and the maps and numerous black and white illustrations provide clear and useful guides to the geographical distribution and identification of critical species.

There is an interesting section on the biogeography of the butterflies of the Eastern and Southern Aegean with many useful tables summarizing the distribution of species on these islands. The work concludes with a very full bibliography which will be a great help to anyone interested in the butterflies of this area and which extends eastwards the reference material easily available to collectors and students of Lepidoptera.

DAVID HALL

THE MOVE TO DINTON PASTURES

Now that the building at Dinton Pastures is completed and the remedial work by the builders 6 months after completion has been approved, it is perhaps appropriate to look back on how this new development in the history of the Society came about and to record some of the pitfalls that arose along the way.

We had one year's notice of the necessity to leave the Alpine Club and, as Frances Murphy has already related (*Br. J. Ent. Nat. Hist.* 1992; 5: 129–132), considerable efforts were made by some Council members to find alternative premises in London. It became evident that affordable space in London to house our library and collections could not be found. Possibilities outside Central London were already being considered by Christmas 1989, when I attended a party at Dinton Pastures with Bill Parker. Bill had run his moth trap in the park regularly over several years, thus meriting an invitation, and I had attended such parties with him in earlier years but had little other knowledge of the area, apart from one collecting visit in 1983.

Bill took this opportunity to ask the country park manager, then Val Workman, if they had any space that we could rent. He was later told about an existing building which might become available in the following April. I then arranged to go down in January 1990 to inspect this building. On my arrival, however, the suggestion was immediately made by Val Workman that land could be made available for a new building to be erected. This was conditional on including in its layout a 'display area' for use by the local authority, Wokingham District Council as an "interpretation centre".

A site occupied by an open-sided barn (described as "Dutch" or "Yorkshire") was offered and it was said that a building of up to 2000 square feet could be considered. This seemed an attractive proposition if the construction could be afforded by the Society. Suggestions as to likely cost were made and it seemed possible, given the legacies recently received, although the cost of maintenance had also to be considered. We had already concluded that a minimum of 1000 square feet was necessary for our needs and 250 square feet was initially mentioned for the Display Area.

I then first raised the suggestion at the February 1990 council meeting, emphasizing the central location in Southern England and easier access by road for members from other parts of the country compared to Central London. So began lengthy discussions that dominated the council meetings of that and the following years. It was evident from the beginning that several council members were enthusiastic that we should go ahead, some were strongly opposed while others were to be convinced later. At the same time options in London continued to be investigated unsuccessfully.

We decided to find out more about what the country park had to offer and a meeting took place there on 9th March 1990 when Frances, Stephen Miles and I met Val Workman and Rod Calder of Wokingham Leisure Services, who confirmed that our taking up residence was a real possibility.

We first needed to know the likely cost of the building and it was agreed that an architect should be approached to carry out a feasibility study. Bob Rigby of James Smith Associates in Maidenhead had been recommended by the local authority. Stephen and I met him on 30th March to brief him on the Society's requirements and work out a preliminary design.

The feasibility study was produced by May 1990 but our immediate reaction was that the cost was 20 per cent higher than the treasurer had suggested we could afford. However, the plans drawn up had been influenced by discussions between the

architect and Val Workman, who had now decided that a larger display area was necessary; the size of the Society's portion had been increased in proportion. We had to advise Bob Rigby of the need to keep to 1000 square feet for our area but we agreed that 300 square feet could be allowed for the display area.

Having decided that a building could be afforded, the Society's council then proceeded to consult members. After much deliberation, the form that the consultation should take was agreed and Colin Plant's letter to members resulted in the gathering of a diversity of views during August. This produced a surprisingly positive result considering the strong opposition from some quarters, subsequently voiced at the annual general meeting in February 1991. Many members, of course, had some reservations, the security of the building being the greatest concern and this had always been a priority in discussions with the architect. The decision was thus made in September 1990 to investigate the option further.

The architect was asked to produce revised options which were closer to our preferred budget; these were also submitted to Val Workman, who had been told that the project had been provisionally approved by us. She had, however, been concerned at the time we were taking to come to a decision. I was now informed that 400 square feet was the minimum area for their purposes and other organizations were interested in the site, so a more definite commitment from us was required. However, a compromise was reached and we agreed on 360 square feet for the display area; it was also by now apparent that high interest rates were rapidly increasing our funds. At that time our member John Phillips offered his expertise at assessing the architect's detailed costings and his assistance was invaluable.

Further discussions with the local authority hinged largely on the length of lease and its detailed terms. We asked Bond Pearce of Plymouth to act as our solicitors and it fell on Mark Swallow of that company to carry out the negotiations on our behalf. Then a change in country park manager intervened. Val Workman left in January 1991 and she was not replaced until Diane Menzies came in April.

Val's imminent departure had evidently led to consideration of the project by the local authority reaching a temporary halt. I approached them to progress the matter and a meeting was arranged with Rod Calder and the property manager Marc Sartorio. This took place at the district council offices on 20th February 1991. On arrival at these offices, I was surprised to find a drawing of the barn we proposed to demolish on display in the reception area of the leisure department. We had already ascertained that the barn was not a listed building and it later transpired that only half of the barn was to go and the remaining span still overlooks our building.

The proposals about the terms of the lease were discussed in some detail. Although leases of 25 to 40 years were usually offered for local authority buildings, they had concluded on 60 years being possible in this case, as being the likely "life of the building" although our architect had confidently predicted "hundreds of years". We wanted at least 100 years but it soom became clear that 70 was the maximum we could expect and this was later agreed. Provisional terms were then received in writing in May 1991 and following extensive debate we requested many changes in detail; most of our concerns were accepted by the local authority and changes were made. The draft lease was then drawn up by the local authority solicitor Mr Dodge, and passed to our solicitor for consideration. He then produced a detailed report, highlighting changes that would be desirable. Then, following our instructions, he entered into a lengthy correspondence with Mr Dodge, which brought about a good number of changes beneficial to the Society. This process continued throughout the rest of 1991.

In the meantime, application for planning permission was made on 7th June 1991 and this was provisionally agreed on 21st August, pending the signing of the lease. According to the draft lease the reverse was necessary and we didn't finally hear that permission was officially granted until two weeks after the builders had taken up residence on the site!

The provisional decision of the planning committee became known on the same day to the *Wokingham News* and I was telephoned by a reporter who asked about the project. The Thursday 29th August 1991 edition of the *News* then included a short article entitled "Top Nature Society to Pastures New" (reported verbatim in *Br. J. Ent. Nat. Hist.* 1992; **5**: 134), in which it was stated that the news that we had chosen to move to Wokingham had "been greeted with excitement from all sides", perhaps an over optimistic view but they had not considered it remotely likely that any of our members might not want to go to Wokingham! The article referred to our "internationally famous" . . . "mammoth collection of insects". The claim was also made that our move would "do the town of Wokingham no end of good" and be a "massive boost" to their environmental programme, so a great future for the Society there was anticipated.

On 27th August, the architect was asked to produce the detailed drawings required for the tender to builders, which took him about three months to complete. However, at the end of September another possible location in London was investigated by Andrew Halstead, John Muggleton and myself and the final decision to go ahead with 'Dinton Pastures' did not come until after the terms of the lease had been approved by our solicitor (in November) and then by the Society's council on 5th December 1991. Some of the further changes in detail asked for by us then were considered favourably by the local authority and were incorporated in the final document presented to our trustees for signing. We had, however, to admit to not having a 'common seal' with which to embellish the lease.

The architect's drawings and his building specification running to 116 pages (largely a standard document, providing detailed instructions on the finer points of workmanship such as the correct composition of concrete) were completed and submitted to five builders during December. The tenders were available by 16th January 1992 when we agreed to accept that by C. F. Rawling & Son of Reading, who had the advantages of the lowest estimate and being well known to the architect. Morris & Young had been selected as a subcontractor to fit an air conditioning system as we wished to control the temperature and humidity precisely; I was assured that any combination would be possible and we have experienced a wide range of these during the subsequent teething problems. Three manufacturers were investigated before finding a system that fitted the building design.

The commencement of building then awaited the signing of a building agreement with the local authority, achieved on 4th February. Agreement of the terms of the lease was implicit in this, but the lease itself had to be signed later, within 28 days of "practical completion" of the building, by both trustees. Stephen Miles, John Muggleton and I had met the builder's representatives on 31st January and they were invited to occupy the site on 24th February. Completion was expected by 3rd July. Delays, however, arose due to several factors outside their control and they must be congratulated for limiting these delays to achieve completion during August.

The barn superstructure had been demolished by another contractor, but after removal of its concrete floor by our builder, a further unexpected slab was found below ground level. As this had to be cut through for the foundations, a new design, involving a suspended concrete floor slab with additional steel reinforcement had to be introduced, requiring fresh involvement of the structural engineers Board & Gloyens.

Then there was controversy over the route for rainwater drainage, because the volume was thought to be too great for the existing system to cope with. This had to be across the neighbouring property 'High Chimneys' to a garden pond; the local authority met the additional costs incurred.

It was revealed in May that a mistake had been made about the water authority for the area—it was Thames, not Mid Southern (they had previously estimated costs without realizing that they were not responsible); costs would be higher and we then found that they expected our builder to lay the connecting run to the country park boundary. This took some time to sort out and the delay in providing a water supply to the building held up the commissioning of the air conditioning sytem.

Problems with the design of the roof trusses were overcome; then on 3rd June we learned that the subcontractor supplying the windows and doors had gone into liquidation (just after delivery of parts) and some accessories took a long time to arrive from Belgium.

It was also found that the air conditioning plant was larger than envisaged and it was found to fill most of the roof space requiring the relocation of the access hatch from the lobby to the collections room. Any hope of storage space in the loft disappeared.

Another minor diversion arose when the VAT inspector visited the builder and insisted that we were liable to pay VAT on the building. Fortunately, they were soon persuaded that our charitable status removed this obligation.

During this building period five monthly site meetings were attended by myself and usually by Stephen Miles and/or John Muggleton, so we kept in touch with progress as the problems outlined above came and went. In May we learned that Diane Menzies was leaving and Richard Stevens arrived to become the third country park manager since the inception of the project.

The building was finally handed over to us on 28th August 1992, with the air conditioning only just operational and the burglar alarm not yet connected. Several visits were made by both subcontractors before these systems were pronounced to be running satisfactorily. Because of prior arrangements with Pickfords, the library and some other effects had to be installed during that period but delivery of the collection was held back so that the collections room could be used for the storage of the tea chests containing the books.

Then on 14th October, only a few days after the burglar alarm had been connected to the company's office and less than two weeks before delivery of the collections was due, I was told at 9.30 p.m. that the alarm had been activated. On arrival at the building, I found a flood entering the collections room via the loft hatch, from a leak in the air conditioning plant. Water had entered the controls of the alarm. Morris & Young and the manufacturers of their plant sent representatives on the next day; the latter was astonished to find that a water tank had been installed vertically instead of horizontally (not the cause of the leak). Several other installation faults were discovered on previous and later visits, but it is getting better all the time!

The burglar alarm also went off on 22nd December, this time when the telephone lines were brought down by a lorry delivering materials to the golf course. The green keeper told me that they had been delivering for years and this had never happened before. Evidently they had not noticed the building; it will hopefully be less inconspicuous when Andrew Halstead's landscaping of the surroundings comes to fruition.

It has been a long drawn out process, far more involved than I had anticipated three years ago, and no doubt further problems remain to be solved. It is to be hoped that these efforts will be rewarded by the building becoming an asset to the Society for years to come.

PETER CHANDLER

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Line figures and half-tones are accepted. Writing on figures should be neatly added, or listed separately for typesetting, its placing indicated on a duplicate figure. Seek advice before drawing. Reduction may otherwise necessitate redrawing. Colour illustrations may be available, please write to the Editor.

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